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THE GEOGRAPHY OF SOUTH AMERICAN RAILWAYS

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A General Survey.

AT a time when every nation is asking how it stands in relation to its fellows, and how it may maintain or improve that relation, I trust it will not be out of place to attempt a survey of this compact group of South American States. In doing so I have adopted their transport system, the railway, and where necessary its complement of river navigation, as a unit, and the policy of each State towards its transport as a standard of comparison. Yet such comparison would be unfair unless we give due weight to the limitations which geography, politics, and their natural resources impose, and these will be examined separately.

South American railways are largely a natural or at least a spontaneous growth. Starting from purely local demands and origins these systems, spreading and ramifying, now assume inter-State and even international proportions. It is impossible here to give more than a general outline of so wide a subject, but Table A and the accompanying map approximately indicate the progress attained at date.* For the purpose of comparison I have added India, with its dense population and State-controlled railways, and Canada, where Government and private effort to develop the country's transport perhaps reaches its zenith in the New World.

The routes we shall study in greater detail are those which so harmonize with the geography, commerce, and politics of each State as to make the railways traversing them a national asset, or, if they have not yet been built, a national want. Railways play an even more important part in South America than in other new countries, not only because of the formidable physical obstacles they cross, but because, largely owing to a scant

* The data from which the figures in Table A are compiled are taken from official and private returns available up to the end of 1914. Owing to the war construction in South America during 1915 was almost suspended, although in urgent cases it has been recommenced. In the almost impossible case of securing simultaneous returns for all South America up to the close of 1916, the margin of error in the above would probably not exceed 1 per cent.

population, there exist no natural highways outside its river and coastal navigation. Public high-roads like those of Europe and North America are unknown. On the pampas and savannahs they are merely the earth enclosed between two wire fences, or impressed by passing wheel-marks; on the Andes, mule-tracks; in the forest, narrow paths cleared by the "machete" of every traveller. Thus in South America the railway of necessity accompanies, and in some places precedes, the colonist, and as every State aims at attracting immigration, the extension of railways within its borders is invariably an important public policy, even in cases where the lines are not State-owned. Railways, moreover, are felt to be a tangible asset. They can be shown to foreign countries as an earnest of present and future progress, and they also afford a rough basis of comparison as between the Republics themselves.

From the standpoint of domestic politics, the speedy and efficient transport afforded by the great railway systems is essential to the State. Not only do they provide the capital cities with an outlet to the ocean, but they strengthen the political link between outlying provinces—which for the most part enjoy a very liberal autonomy—and the Federal Executive. Until this is accomplished there is danger, as experience has shown, not only of political unrest but of uneven progress within the Republic, due to the embargo placed upon personal intercourse between the central and the more distant governing bodies. Apart from their obvious task of developing regional resources, the railways of each South American Republic are therefore an important and even an essential part of the practical machinery of its Government.

TABLE A.*
Comparative Railway Progress of South American States, 1914-1915.

	Population.	Area in sq. kms.	Approx. Rail-way km. in 1914-5.	No. of sq. kms. of Railway.	Popn. per km. of Railway.
Argentina	7,979,259	3,919,997	36,531	107	218
Chile	3,596,541	750,852	8,379	87	429
Uruguay	1,315,714	186,924	2,585	72	508
Dutch Guiana	85,536	119,326	140	852	611
Brazil	17,318,556	8,339,354	25,506	327	678
Paraguay	850,000	429,461	587	728	1,448
Peru	4,620,201	1,871,660	2,828	626	1,630
British Guiana	296,000	231,813	152	1,525	1,947
Bolivia	2,899,970	1,332,007	1,333	999	2,175
Ecuador	1,500,000	300,518	644	466	2,329
Venezuela	2,816,484	1,032,626	936	1,103	3,009
Colombia	5,071,101	1,142,088	1,108	1,030	4,576
French Guiana	49,009	82,901	Nil.	—	—
Total—South America	48,398,371	19,737,527	80,729	244	599
India	315,000,000	4,670,023	70,352	66	4,477
Canada	7,206,643	9,662,344	49,559	195	145

Note.—The figures of Population and Area, which vary considerably in different

Underlying Factors.

The control which the geography of any State exercises over its transport system, although it remains the basis of all calculation, tends to recede more into the background as political and commercial interests develop. We see one end of this process in great cities like Buenos Aires, where the original topography is almost entirely obliterated. The docks and terminals extend a mile beyond the natural shore-line of the River Plate; the Riachuelo stream, which marked the original entry to the Argentine capital, is undergoing transformation into an industrial canal; while the congested inhabitants, imitating the Londoner and New-Yorker, already dive into "tubes" in preference to exercising their privilege of walking on the city's surface. At the other extreme the demands of science have created settlements in an absolute desert on the Pacific coast, for the purpose of extracting nitrate deposits; and mining railways in Peru and Bolivia search for freights on the Andean snowline at over 15,000 feet. Both topography and geography may therefore be subordinated to political and economic pressure, which converts into strategic highways routes that under other circumstances would have remained long untraversed; or curtails and sometimes even ignores the roads which Nature has provided.

South America, if not an island, is a peculiarly self-contained continent, and its isolation is emphasized rather than modified by the opening of the Panama Canal. In North America one-third of the entire coast-line faces the frozen Arctic circle, while its Pacific coast did not receive a full share of settlement for over two hundred years after the Atlantic coast had been colonized. In South America, on the contrary, every part of its 15,000 miles of shore-line, lying chiefly in the tropic and temperate zones, is alive to-day with coasting traffic. Exploration of all its shores proceeded rapidly, and was accompanied by equal settlement on the Pacific and the Atlantic sides, even in inhospitable Patagonia and Magellan, until the famous Straits, after Drake's discovery of open sea south of Cape Horn, lost their importance. A striking result of this early and simultaneous settlement has been that every South American Republic, except Bolivia and Paraguay, acquired a freehold on the ocean and the limits of this frontage, until the era of railway construction, formed their chief political preoccupation. Only one Republic, Colombia, faces on both the Atlantic and Pacific Oceans, unless we include Chile's fractional holding at the eastern entrance of the Straits of Magellan.

In the South American Republics political control crystallized round authorities on South America, have been adopted from the Statesman's Year Book (1916 Edition).

* In this and succeeding tables the following metric equivalents may be useful for reference:—

1 lineal metre	= 3'28 lineal feet.	2'6 square km.	= 1 square mile.
1 ,, km.	= 0'62 lineal mile.	100 ,, hectares	= 1 square km.
1 ,, league	= 3 lineal miles or 5 km. (about).	1 square league	= 9 square miles.
1 hectare	= 2'47 acres.		

the coast cities founded by early Portuguese and Spanish explorers. The domination of these two Powers within the continent, in spite of coastal raids by the English, Dutch, and French, was unbroken from the seventeenth to the beginning of the nineteenth century. The methods by which they extended their influence were distinct. The Portuguese were a maritime and trading nation; the ocean was their connecting link with the mother country. Their colonies, or "Capitanias," centred upon the many excellent harbours which enrich the coast of Brazil. The Portuguese disliked losing sight of blue ocean; Vasco da Gama would never have burned his ships as did Cortes. The search for open "campos" in the States of São Paulo and Parana occupied cautious expeditions from the Brazil coast for a period of over one hundred years. The Spaniards adventured more boldly, possibly owing to the lure of gold, which led them into the high Andes. Be that as it may, they always struck inland, and while their settlements on the coast were weak, their grip on the immediate hinterland was strong. When the allegiance to Spain was shaken off in the early nineteenth century the old Spanish Vice-regal centres upheld their autonomy and became each the nucleus of the present nine Spanish Republics. The more flexible maritime bond which linked Portugal with the Brazil coast was not so easily broken, and it was not until 1889 that the Portuguese empire in South America, still intact, declared itself the United States of Brazil. Whether it be due to geography, expediency, or hereditary instinct, I do not pretend to say: the fact remains that every railway system in Brazil culminates in a good natural port, while in Argentina, Chile, and Spanish America generally they usually build their railways inland first, and apparently only attend to their harbours when forced by necessity to do so.

There are thus ten self-governing Republics in South America: Brazil, Uruguay, Paraguay, Argentina, Chile, Bolivia, Peru, Ecuador, Colombia, and Venezuela. The Guianas—British, Dutch, and French—and the Falkland Islands, being colonies administered from Europe, we will leave for the moment aside. These ten autonomous political states each determine the strategic value of the transport routes, and, in consequence, of the railways constructed within their borders. South American States have so far shown little conception of mutual interests, unless a tacit endorsement of the Monroe doctrine—which in their case applies to the United States equally with European nations—can be so interpreted. Their domestic policy—which as we have seen is intimately connected with their railway programme—has been individual and strongly protectionist. Only very lately has the question of international railways within South America been taken at all seriously. As a result there has been little or no helpful consultation between one Republic and another, and certainly no standardization in the equipment or operation of their respective railway systems. Nothing brings out this point more clearly than the amazing variety of gauges which have been allowed to spring up in such tropical profusion on the coasts of South America, as shown in Table B.

TABLE B.

Total Railway Kilometrages of South American States, with Analysis of Gauges used.

	5 ft. 6 ins. 157 m.	5 ft. 3 ins. 166 m.	4 ft. 9 ins. 144 m.	4 ft. 8½ ins. 143 m.	4 ft. 7½ ins. 140 m.	4 ft. 7 ins. 137 m.	4 ft. 6 ins. 134 m.	4 ft. 5 ins. 127 m.	3 ft. 6 ins. 107 m.	1 m.	3 ft. 0 ins. 91 m.	2 ft. 6 ins. 76 m.	2 ft. 0 ins. 61 m.	1 ft. 8 ins. 45 m.	Small indu- strials, no data.	Total kilo- metrage.
Argentina	21,047	...	...	2,706	...	...	...	...	...	11,545	...	949	284	...	...	36,531
Brazil	...	1,450	...	...	13	10	...	...	16	22,417	...	730	523	...	347	25,506
Chile	2,255	...	29	935	...	...	...	9	186	501	2,801	10	1,377	246	15	8,379
Peru	...	...	...	1,997	...	...	...	...	...	214	488	67	52	...	10	2,828
Uruguay	...	...	...	2,564	...	...	...	...	...	...	...	...	...	...	21	2,585
Bolivia	...	...	...	...	...	...	...	...	...	1,127	...	206	...	...	...	1,333
Colombia	...	...	...	...	...	...	...	...	...	240	827	...	...	...	41	1,108
Venezuela	...	...	...	...	...	...	...	...	...	175	193	...	176	...	57	936
Ecuador	...	...	...	...	...	...	...	...	...	504	...	140	...	...	...	644
Paraguay	...	...	...	376	...	...	...	...	20	...	73	...	...	...	...	587
British Guiana	...	...	...	97	...	...	...	...	24	31	...	...	...	...	...	152
Dutch Guiana	...	...	...	...	...	...	...	...	...	140	...	...	...	...	...	140
Total kilo- metrage	23,302	1,450	29	8,675	13	10	9	186	1,380	38,710	1,518	3,542	1,281	15	609	80,729

Mountain Railways.

The mountain railways which scale the Atlantic and Pacific coast Sierras are the most striking feature in the transport routes of South America. Locally considered they illustrate a hard-won political or commercial success over geographical disabilities. The wider underlying reason of their construction, however, is that South America contains a greater proportion of the tropical zone than any other continent. It is altitude and not latitude which determines the amenities of life in the tropics. The Portuguese, and still more quickly the Spanish officials, early appreciated this fact, which was largely responsible for the efficiency and persistence of their rule. The presence of mountain ranges and plateaux close to either coast led to settlement on the uplands, and subsequent high-roads and railways to the coast towns were a natural corollary. This tendency was especially marked on the Pacific shore, where the example was already given by the Inca Empire, with its capital cities and its high-roads upon the high Andes. How early this system of the upland city as a complement to the coast port was established throughout tropical South America will be seen in Table C (where these examples are bracketed). The cities of Rio, Buenos Aires, Asuncion, and Lima combine the functions of capital and port, without any companion upland town. These and others have however been included in the list, since the date of their founding shows that simultaneous occupation of the South American coast which we have already noted as presenting so marked a contrast to the conditions which prolonged settlement throughout North America.

TABLE C.

Showing complementary Coast and Upland Towns, with early settlement of Capitals on South American Coast.

City.	Country.	Latitude.	Altitude.	When founded.	Present Status.
		° ' "	Feet.		
São Paulo } ...	Brazil	23 34 S.	2382-2935	1554	Provincial capital.
Santos } ...	"	23 55 S.	—	1543-6	Atlantic (river) port.
Curytiba } ...	"	25 38 S.	2916	—	Provincial capital.
Paranagua } ...	"	25 34 S.	—	1560	Atlantic port.
Rio de Janeiro ...	"	22 53 S.	—	1560-7	Federal capital and port.
Bahia ...	"	13 0 S.	—	1549	Provincial capital and port.
Pernambuco ...	"	8 3 S.	—	1526-30	Provincial capital and port.
Para (Belem) ...	"	1 30 S.	—	1615	Provincial capital and Amazon port.
Montevideo ...	Uruguay	34 53 S.	—	1726	Federal capital and River Plate port.
Asuncion ...	Paraguay	25 21 S.	235	1535	Federal capital and Paraguay River port.
Buenos Aires ...	Argentina	34 35 S.	—	1535-42	Federal capital and Atlantic (river) port.

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City.	Country.	Latitude.	Altitude.	When founded.	Present Status.
		° ' "	Feet.		
Santiago } ...	Chile	33 26 S.	1860	1541	Federal capital.
Valparaiso } ...	"	33 0 S.	—	1536	Pacific port.
La Paz ...	Bolivia	16 30 S.	12,120	1548	Federal capital.
Cochabamba ...	"	17 20 S.	8400	16th century	Provincial capital.
*Lima (Callao) ...	Peru	11 50 S.	480	1535	Federal capital and Pacific port.
Arequipa ...	"	16 23 S.	7753	1540	Provincial capital. |
Quito ...	Ecuador	0 13 S.	9343	1533	Federal capital.
Guayaquil } ...	"	3 0 S.	—	1535	Pacific (river) port. =
Bogota ...	Colombia	4 35 N.	8563	1538	Federal capital.
Cartagena ...	"	10 30 N.	—	1533	Caribbean port.
Caracas ...	Venezuela	10 35 N.	3025	1567	Federal capital.
La Guayra ...	"	10 30 N.	—	1588	Atlantic port.

When we examine them in more detail we shall find that the railways to these upland cities usually cross *en route* an even greater altitude than that of the capital itself, while certain lines built for commercial traffic, notably in Peru, Bolivia, and Brazil, rival even the achievements of the politico-mountain railways.

The Interior Basins.

Mountain ranges and plateau ramparts are not, however, the most formidable barriers which block the construction of strategic roads in South America. Behind the Cordillera and the plateau, and far away from the easy southern pampas, lie the interior tropical valleys of the Parana, Amazon, and Orinoco rivers. Their basins, counting only the area under the 1000-foot contour, cover one-fifth of the whole continent, and are as full of water as a wet sponge. The Amazon alone † reckons over 50,000 kilometres of navigable waterways. All streams in these regions, fed by the snows of the Andes and by a rainfall ranging from 80 to 140 inches a year, are liable to great and periodic floods, involving startling variations of level. Transport problems in these river-basins involve bridging rivers or traversing them by train-ferry, and crossing watercourses, flood-areas, and swamps in districts where maintenance is often as costly and difficult as the original construction. Such tropical basins contain hardly a square mile of unfertile, even if temporarily water-logged land, while the luxuriance of their forests, which have so delighted Humboldt, Darwin, Bates, and indeed every visitor to South America, is but an added and unrelenting obstacle to the railway engineer.

* The actual port, 12 miles across flat country from Lima Cathedral, is of course Callao.

† The area of the entire Amazon watershed has been estimated at about 6,430,000 km., equal to five-sixths the area of Europe. "This labyrinth of rivers, rapids, and lagoons does not constitute so much a river as a freshwater ocean, infringed upon and divided by ground. We cannot consider as *terra firma* a region which extends from one extremity to another of the continent, and which for half the year is under water" (Agassiz).

As in the early days, the great rivers still form almost the only practical highway in the tropical basins. The task of the railway here is to assist, where it cannot supersede, river navigation by linking separate streams, by affording portage between their upper and lower reaches, and finally by providing an alternate outlet past the dangerous bars and sandbanks which invariably mask their outlet to the ocean. This function of the railway, as an adjunct to fluvial transport, while less spectacular than the scaling of mountain heights, is no less important to the development of the continent, and as settlement gradually penetrates the interior basins it is one which will be increasingly called for.

Frontier Agreements and International Railways.

The map shows us how early settlement, dating back to the Inca Empire, and later the political momentum of the Republican capitals, pinned strategic transport routes on or near the coast. The South American States stood for three hundred years with all their wares, so to speak, in their front windows, disregarding or at least losing sight of the potential wealth that lay behind. So firmly did their statesmen maintain their grip on the outer rim of the continent, and so little did they value its hinterlands, that at the commencement of the twentieth century Chile and Argentina nearly came to blows through ignorance of plain geographical facts affecting their frontiers in Patagonia—in a region as fertile and much more accessible than Canada's Alberta province, and already roamed on horseback and on foot by the Tehuelche Indians, following trails abundantly supplied with wood, pasture and game, for over two centuries.

Yet if the awakening of the Republics to the potential value of their hinterlands has been tardy, it has been fairly complete. The last fifty years, coinciding with railway construction, has seen an almost equal number of boundary settlements in every part of the interior. These frontier agreements, if they have not actually led to railway building, have all yielded a valuable by-product of accurate surveys. They have, moreover, resulted in a better understanding between these curiously self-centred South American States. The international railways, whose commencement we are now witnessing, will greatly promote a comparison of national ideas and policies. Such interchange, together with the provision of accurate, recent data, and especially maps, is one of the very real though less obvious wants of official South America to-day.

The enforced seclusion in which each of the ten Republics has attained its growth makes it inevitable that their transportation problems be treated separately, and this method has been adopted in the succeeding pages. Its further justification is found in the very definite control which, as we have already noted, political bodies exercise over the main trade routes used by the bulk of their population. Howsoever Nature may rough-hew the highways of any given region, it is the Government which finally shapes their ends. Yet the political preferences among the





Sketch
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CABLE HOISTS, SÃO PAULO RAILWAY, SERRA DO MAR, BRAZIL



THEOTONI RAPIDS, RIO MADEIRA, BRAZIL





numerous factors affecting transport are by no means a fixed quantity in every Republic, as we shall presently see. The greater the political harmony that prevails between two or more adjacent states, the less are they likely to run counter to the lessons of geography when dealing with common transportation interests.

Thus while for statistical purposes and for convenience of reference we utilize the newer divisions—a political mosaic set in hard geographical cement—let us never lose that vision of South America as it first appeared to our forefathers, a land set apart and cradled by twin oceans, buttressed by continental ranges and scored by thousand-league rivers; a whole, compact, and marvellous New World.

BRAZIL

The coast-line of Brazil, upon which all its railway system gathers, is divided for the purposes of this survey into three sections, each roughly 1000 miles in length, and each closing upon a major seaport. These ports, from north to south, are Pará, at the mouth of the Amazon; Pernambuco, the most easterly capital of South America; Rio de Janeiro, sheltering its city within a bay land-locked for sixteen miles; and Rio Grande do Sul, close to the Uruguay frontier. Throughout this 3000 miles of Atlantic coast there are, as the map shows, many other great seaports which are also railway termini. The above sections are chosen, however, because they mark stages of regional development in the programme for paralleling or short-circuiting existing sea and river routes, which forms the keynote of Brazil's Federal railway policy.

In the southern section, from Rio Grande do Sul to Rio de Janeiro, through rail communication is already established. In the middle section between Rio and Pernambuco, about half the distance can be covered by rail, although the lines in this region were originally built for local service only, and will need considerable readjustment and bridging of gaps before they reach the continuity already obtaining in the south. Inland travel is already possible between Rio and Bahia by utilizing 740 miles of the northerly flow of the River São Francisco, in conjunction with the lines of the Central of Brazil and the North Bahian systems. On the third and most northerly section of the Brazilian coast, between Pernambuco and Pará, the Federal programme is still in an embryo stage, and only short penetration lines run inland from isolated harbours. Government plans in this region, however, are ambitious and include a trunk line dropped south through Pará and Goyaz States, linking up with the Minas system and with Rio, thereby passing behind and leaving to the east the great Pernambuco bight. A similar cut-off, but affecting a smaller area of coast-line, will be the railway planned and partially constructed between St. Luiz, capital of Maranhao, and the city of Bahia.

North of Rio State a modified coast range still faces the sea, but the main mountain chains retreat, reaching their highest points between the São

Francisco and Tocantins water-partings. The northern coast drainage is thus carried inland and then northwards by these two great rivers, but a number of lesser streams thread heavily wooded valleys and foothills by the Atlantic shore. It is a difficult country to open up, and railway building will always be slow. Above the 3000-foot contour, however, most Brazilian highlands show abundant though coarse pasture, and this condition holds good throughout the great interior plateaux of Minas Geraes, Piahy, Goyaz, and Matto Grosso States.

In south Brazil, the Serra do Mar, a range better described as the sea-face of the southern plateau, presents an almost unbroken barrier for nearly 1000 miles of coast, commencing 150 miles north of Rio Bay. The plateau terminates, and the Serra do Mar barrier which is its outer face therefore turns inland about midway through Rio Grande do Sul State, whose southern half thus affords unbarred access from the sea. Elsewhere along the whole Serra do Mar front, after crossing a strip of coast flats from 10 to 30 km. broad, any penetrating railway enters quickly upon abrupt foothills, leading a few kilometres further to almost vertical cliffs with summits from 2500 to 3000 feet high. A few short coast streams, such as the Ribeira, north of Paranagua port, and the Itajahy in Sta. Katarina State, cut into the formation, but in any case the climb up to the plateau must ultimately be faced.

The railway ascent of the Serra do Mar has thus far been based upon four ports. (1) From Rio Bay there are four lines, two owned by the Central of Brazil (State) Railway, and two by the Leopoldina Railway Company. (2) From Santos port to São Paulo, capital of that State, the climb is made by the line of the São Paulo Railway, the only double-track mountain railway on the continent. (3) From Paranagua Bay to Curytiba, capital of Parana, by a mountain section of the São Paulo-Rio Grande Railway; and (4) from São Francisco Bay, Sta. Katarina State, to Tres Barras station, near the headwaters of the Iguazu River by another mountain section of the same railway.

It will thus be seen that each of the four southern states of Brazil has a separate rail outlet from the plateau down to the sea, while a fifth, Rio Grande do Sul, is enabled to outflank the barrier. Moreover, of the nine mountain railways on the Atlantic coast of South America, the seven lines just enumerated (in which I do not include the "funicular" tourist railway that runs up Tijuca peak overlooking Rio) are all grouped on the flanks of the Serra do Mar. They form the outlet for all important development on the South Brazil plateau, and their value automatically increases with the growth of settlement in this, the richest area of Brazil.

If we regard the railway system south of Rio as a whole, however, we find that one section predominates in every sense. It is that portion of the system of the Central Railway which ascends the Serra and turns westward along the Parahyba Valley to São Paulo (496 km.), and thence links with the São Paulo line down to Santos port (78 km.),

making 574 km. in all. This Rio de Janeiro-São Paulo-Santos loop is a main artery of traffic joining the two chief cities and ports of the Republic. The Santos section (British owned) shows a traffic-earning capacity per kilometre superior to any other railway in North or South America. The political and commercial momentum enjoyed by the combined tracks connecting Rio and Santos is thus enormous, and makes this short loop easily the premier transport line, not only in Brazil, but possibly in all South America. The lines laid in the Parahyba Valley form the principal connection between all the great railway systems to the south and north of Rio. Under these circumstances the use of the Brazilian broad gauge, viz. 5 feet 3 inches, between Rio and Santos is probably a mistake, although it will never be rectified. The later constructions of the Central Railway have been chiefly to 1-metre gauge, while the lines of the Leopoldina, Paulista, Mogyana, Sorocobana, North-West of Brazil, and São Paulo-Rio Grande, all of which directly connect with or feed the Rio-Santos section, are built almost exclusively to the 1-metre gauge, to a total of 9851 km. The greater carrying capacity of the broad-gauge portion is therefore far outbalanced by the blockade it offers to any interchange of rolling stock in a busy season, even apart from the necessity of rehandling all the enormous and increasing traffic which converges upon it.

The different methods employed by the lines scaling the Serra do Mar are of interest. The *Central of Brazil Railway*, which began building its first line in 1857, adopted the shortest route, and worked to the ruling gradient of 2 per cent. by a free use of tunnels. It has sixteen principal tunnels, of which the longest (7336 feet) passes under the crest and into the Parahyba Valley at an elevation of 1450 feet. Its auxiliary line, like the trunk railway, crosses low marshy ground up to the foot of the Serra, but at this point deflects northwards, developing a longer track with less difficult gradients, till it also reaches the River Parahyba, some 78 km. downstream from the São Paulo branch.

The *Leopoldina Railway* (British), which fused and extended the scattered lines lying east and north of the Central Railway's State system in Rio de Janeiro, Espirito Santo, and Minas Geraes, also makes a double ascent of the Serra, but at widely separated points. One branch, starting from Rio City, climbs to Petropolis, a residential suburb $2\frac{1}{2}$ hours distant. The 2676 feet rise from the foot to the summit of the Serra is accomplished by means of a Riggenbach rack on an average grade of 13 per cent., with a maximum of 19 per cent., and is the steepest working railway (outside Tijuca) on the continent. The Leopoldina's second ascent is made by a line starting from Nictheroy port (on the opposite side of the bay to Rio City), which meets the Serra on what is known as the Fribourg section. The climb here is 12 km. long, with an average gradient of 7.1 per cent. and a maximum of nearly 9 per cent., which is accomplished by *adhesion only*, i.e. without rack or cable. This is the steepest grade operated on

adhesion by any public steam railway in the world. Locomotives of special type are employed, and the trainloads are limited to 60 tons.

The *São Paulo Railway* (British built and managed) has also two lines up the Serra; the first and original line a single track; the second—which has superseded the first for all ordinary traffic—a double-track line located slightly higher up the hillside. Both these lines surmount the Serra by a series of inclined planes up which trains are hauled on the cable system. On the new line the inclined planes have a gradient of 8 per cent. or 1 in 12½. There are five such inclines, which run almost parallel with those of the older track. On this older track the management contemplate replacing steam operated cables by rack sections operated by electric motive power. When carried out, this change will be one of the pioneer installations of electric power for heavy mountain railway work in South America, and its example will almost certainly be followed later by the electrification of similar lines elsewhere.

Since the new inclines and the doubling of the line have been contemplated, the development both of the traffic and of the city of São Paulo has been continuous and rapid. The coffee exported to Santos and handed over the São Paulo line in 1913 was 669,485 tons, which, however, only represented 20 per cent. of the entire import and export freight carried by the railway for the state of São Paulo. As the maximum train-load on the inclines is 145 tons, the achievement of the railroad in handling this great traffic over a difficult mountain section is striking. The railway's monopoly of this Santos port traffic has only been attained by an expenditure of over £6,600,000, a large proportion of which has gone to the construction of the 10-km. mountain sections. The chief reason for this great expenditure, and also for the reluctance of other railways to face the Serra do Mar ascent, is that under heavy rain, the hillsides develop a constant tendency to landslips. The framework of the mountains is of granite, but the rock only outcrops through a heavy overburden of soil, rubble, and tropical surface vegetation. The effect upon the line of surface and underground seepage induced by tropical rains, has to be corrected by underpinning, by huge retaining walls over great portions of the track, and by open drains, catchment wells, and culverts innumerable. Surface slipping and creeping of the hillsides be it noted, are troubles common to almost every mountain railway built in South America, excepting always the trans-Andine railways upon the waterless coasts of Northern Chile and of Peru.

The *Paranagua-Curityba* Serra line of the Parana Railway is more picturesque than sensational. The summit is reached at 3122 feet after a 40-km. rise, where the maximum gradient does not exceed 2·7 per cent., allowing of effective loads up to 120 tons to be hauled with a somewhat inadequate equipment. The track of 1-metre gauge winds cleverly up a series of foothills and side spurs, finishing with a tight-rope performance along the upper Serra cliffs on viaducts which stick out over sheer drops

of 1000 feet. The line has hardly 50 metres of track without a curve, and the views seaward are particularly fine.

The mountain section of the *São Paulo-Rio Grande Railway*, the most southerly ascent of the Serra, starts from São Francisco, the best harbour between Santos and Montevideo. After overcoming the Serra the railway reaches Tres Barras on the upper reaches of the Iguazu River, where extensive mills convert the Araucaria pine forests into lumber for export.

South of São Francisco is the short *Blumenau Railway*, lying in the Itajahy coastal valley, almost entirely populated by German colonists. On the coast between São Francisco and Porto Alegre are settled all the German colonies in South Brazil, to an estimated population of about 350,000. It was on their influence that the Imperial schemes for a Teuton South America were presumably based. My short experience in this district some twelve years ago, however, failed to detect any ardent desire on the part of the rank and file of these prosperous colonists to set up the German eagle in opposition to the flag of their adopted country, although a certain proportion may have since succumbed to an ill-advised propaganda. Most of the German emigration to Brazil took place in the sixties and early seventies of the last century, and there are in this region almost equally large Polish and Italian colonies, that came out somewhat later.

The Southern Plateau Lines.—The railways which jointly provide a through rail service from São Paulo to the Uruguayan border can hardly be called strategic, except in so far as they bring the capitals of these southern states into closer touch with the Federal Government at Rio, thus rendering impossible a repetition of the conditions under which Rio Grande do Sul for instance, at the close of the last century, prolonged a revolutionary movement for no less than seven years. By the junction at Sant' Annà in 1913 of the Rio Grande and Uruguayan railway systems it is now possible to travel by rail from Rio to Montevideo. The distance by the shortest route over the existing lines of the Central, Sorocobana, São Paulo-Rio Grande, and Rio Grande systems is 2626 km., while an additional 570 km. over the Uruguay Central line brings the total rail journey up to 3196 km. This compares with a sea journey between Rio and Montevideo of 1633 km. (1015 miles). No through timetables are available, but allowing 30 km. per hour, including stoppages, as a fair long-distance average for mail trains, the journey if continuous would occupy rather more than four days, with changes from 5 feet 3 inches to 1-metre gauge at São Paulo and again from 1-metre to 4 feet 8½ inches (standard gauge) on entering Uruguay. Coming from the north, by defecting halfway through Rio Grande to Uruguayana on the banks of the Uruguay River, the traveller can alternately journey to Montevideo by a series of small loop lines more or less following its course; or crossing the river he can complete his journey through Entre Rios (Argentina) by rail and train-ferry to Buenos Aires.

Fully allowing for the advantages gained, especially to local mails and passengers, from a daily service between Brazil, Argentina, Uruguay, and Chile on the international route whose first section is here outlined, it is obvious that under normal conditions the railways paralleling the Serra do Mar coast cannot at present supersede the ocean service. The separate lines making the connection are as yet barely, or badly, co-ordinated. The railway journey saves only three days on the seven-day steamer schedule from Rio to Buenos Aires, which also allows for a stop at Santos. The sea service is not only more comfortable, but less expensive. Bulk traffic, such as coffee from São Paulo, the pine lumber, yerba and bananas from Paraná and St. Katarina States, makes for the sea direct by the short Serra lines. But these international lines are also indirectly doing good work by increasing social and commercial intercourse between the Republics. Freer interchange of ideas and travel across political frontiers already constitute an advance which is not reflected in mere traffic returns. Finally, against the sea journey may be set the South American horror of sea-sickness, which can certainly be avoided by using the alternative inland route.

São Paulo-Corumbá Line (North-West of Brazil Railway).—Rail communication was in 1916 established between São Paulo and Corumbá, a port situated on the west bank of the Paraguay River (to which frequent further reference will be made), by the North-West of Brazil Company's prolongation of the Sorocabana railway. The line is of considerable political importance and presents many other features of interest. Its pioneer track, without a branch or junction throughout the 1400 km. from Baurú to Corumbá, penetrates further from the coast into the interior of Brazil than any other railway. In fact, the length of railway from Santos to Corumbá, viz. 1919 km., is only paralleled, as an east-to-west line of transport within Brazil, by the Amazon River from Para up to and beyond Manaos.

The North-West of Brazil was the first railway to link the coast with the valley of Alto Parana, whose basin drains inland almost every river in São Paulo, Sta. Katarina, and Parana States. Further west, in crossing Matto Grosso its line opens up for the first time the interior of a state twice as large and potentially more fertile than Texas.* The journey from Rio to Corumbá was formerly made by sea to Montevideo, and thence up the Paraguay River, 6000 km. in distance and four to six weeks in time, according to the state of river navigation on the Upper Paraguay. By the overland railway the journey to Corumbá is cut down to a three days' run. Besides thus greatly assisting interior administration, the line incidentally covers and protects some 3000 km. of Brazilian frontier with Bolivia and Paraguay.

* Mello gives the area of Matto Grosso as 1,376,487 km. = 531,324 square miles. Texas has 265,896 square miles.

This railway across Matto Grosso also illustrates how political control often diverts the transport of any given region from natural to artificial lines. Either extremity of the Matto Grosso section is served by the Alto Parana and the Paraguay, great and navigable* rivers which as they flow southward form respectively the eastern and western boundaries of the State. Southern Matto Grosso is thus an inland territory in very much the same position as Paraguay, with a natural outlet by the River Plate, and it will be interesting to note its development under the competing rail and river pull, west-to-east and north-to-south. The railway bridge at Itapura, 2637 km. (1637 miles) above Buenos Aires, will be the first erected over the Parana, though the river is crossed lower down by the Posadas and Ibicuy train-ferries operated by the Corrientes and Entre Rios railways (Argentina). Shortly above the Itapura railway crossing the Uberaponga Falls mark the northern limit of the interior Alto Parana basin, whose southern exit is closed by the Fall and Rapids of Guayra. This upper basin of the Alto Parana affords navigation for craft of 3½ feet draught for 2000 km. Unless and until the obstacle at Guayra is overcome, all traffic on these interior waterways will perforce come upstream to connect with the railway at Itapura, a reversal of the original transport provided by the countryside.

At present Matto Grosso's only exports are hides and cattle. Its hitherto neglected grazing lands are now being rapidly developed, the prospects of the cattle trade in Brazil being considerably stimulated by modern meat-packing and freezing factories lately set up at São Paulo and Rio.

The Coffee Lines.—Before leaving South Brazil we should note the Paulista and Mogyana systems, totalling nearly 3000 km., which serve the great coffee plantations of São Paulo State. Brazil exports other produce, rubber, cotton, sugar, tobacco, etc., but her income from overseas is chiefly dependent on her enormous coffee crop. Three-quarters of the world's coffee comes from Brazil, and of that total two-thirds is grown in São Paulo, mostly on the lines of these two railways. There is no other instance of a great country depending so entirely on a single crop,† grown within an area so small when compared with its total bulk. The Mogyana and Paulista are also striking though not unique examples of soundly managed private lines, and their consistently good record shows that the principles of railway management have been well learned in

* The Falls of Guayra, which are the first definite break to continuous navigation on the Alto Parana from the south, occur at the extreme south-eastern limit of Matto Grosso State. Further south navigation is however limited to 3½-foot draft in normal water by the rapids of Apípe, between the river ports of Posadas and Corrientes. The Paraguay river on the other hand gives fairly good navigation in normal seasons for vessels drawing 10 feet up to Asuncion and 6 feet up to Corumba.

† The United States Bureau of Foreign and Domestic Commerce gives the coffee crop of Brazil at 1,200,000 long tons, grown on about 4,500,000 acres. This is equivalent to 18,211 square km., or 1/457th part of Brazil's total area.

Brazil. Two features call for special comment. In accordance with a policy of high general efficiency which has made the *Mogyana Railway* one of the most successful railway undertakings in South America, the company has equipped construction shops at Campinas, where about a dozen of its locomotives were built. This makes the railway stand out from the majority of locally owned lines in South America, which are content to import both locomotives and rolling stock from abroad. The *Paulista Railway* has begun the planting of trees on a large scale, for use both as fuel and for sleepers on the line. These trees, chiefly eucalyptus, are now grown in four plantations at 300 km. average distance from the coast. That a well-organized railway operating in a country where, in the districts served by its own lines, dense forests already exist, should deem it worth while to foster artificial plantations may surprise those who do not realize what "forest" in the tropics means. The only South American forests which are nearly homogeneous, and can therefore be easily exploited, are the Araucaria pine-belts which grow on the Southern Brazilian plateau from 1500 feet to 2500 feet altitude; the Quebracho (hardwood) forests of the Chaco on the Lower Parana and Paraguay rivers; Araucarias and oaks on the Andean foothills in South Chile and in Patagonia; and the beech forests of Tierra del Fuego and Magellan. Outside these comparatively small areas, most forests in South America are tropical jungles. In such forests about 20 per cent. may be very roughly classified as true "hardwoods," another 30 per cent. are "soft" woods, useful as building lumber, and the balance of 50 per cent. are creepers, parasitic growths, or trees useless on account of their texture, habit, or condition. Owing to the prevalent system of making fire clearings or "rossas" in order to plant temporary crops, which in two or three years are again abandoned, the destruction of virgin forests proceeds much more rapidly than most observers, including the Governments interested, have any idea of. Unless, therefore, better methods of clearing are enforced and the forests exploited more systematically, the hardwoods which are the real wealth of Brazil's "Matto Grosso" or "big woods" will continue to go up in smoke, when fresh expense must be incurred, as the Paulista Company has shown us, in growing inferior lumber to take their place.

The São Francisco route (rail and river).—One of the first objectives of the Central of Brazil (State) Railway was the opening up of rail connection with the São Francisco River, which for some 2896 km. (1800 miles) flows northward in a valley roughly parallel to, and at an average of 500 km. from the coast, passing through Minas Geraes and Bahia, entering the Atlantic south of Alagoas State. The Central Railway tracks run 1006 km. almost due north from Rio, to meet the river at Pirapora, from which point to Joazeiro, 1082 km. downstream, there is uninterrupted navigation. At Joazeiro the river is 700 metres broad, and in exceptional floods has risen over 20 feet. A line 577 km. long from Bahia Bay connects with Joazeiro, making a rail and river total between



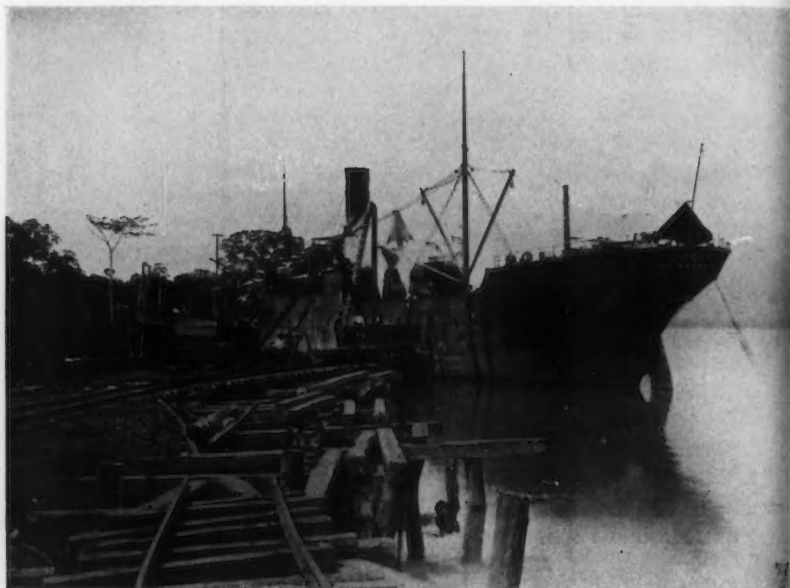




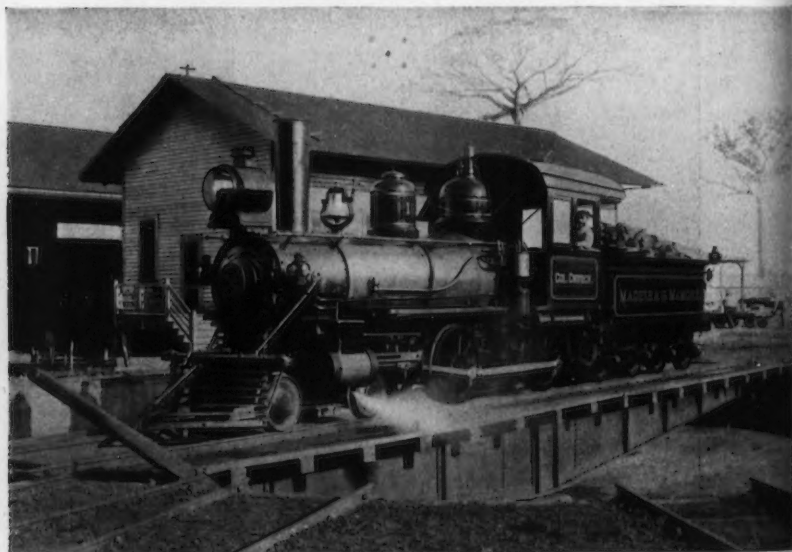
HOMOGENEOUS PINE FOREST AT TWO THOUSAND FEET, PARANÁ



MIXED FOREST ON ROAD TO IGUAZÚ FALLS, ALTO PARANÁ



PELO CUSTO WHARF, PORTO VELHO, RIO MADEIRA
S.S. "Hydra" (7000 tons) unloading coal



LOCOMOTIVE REBUILT AND NAMED "COLONEL CHURCH," MADEIRA-MAMORE
RAILWAY



Rio and Bahia of 2665 km. (1655 miles) by the inland route. Against this the passage from Rio to Bahia by sea is 1186 km. (737 miles).

Downstream from Joazeiro for 122 km. the river is still navigable as far as Boa Vista for smaller craft drawing 3 feet. From Boa Vista to Jatoba, however, over a further 264 km. the river's course is broken by some fifty rapids, great and small. The Federal Government started to clear the channel here, but the work was abandoned in 1896 after thirteen years' work, its chief result being an immense landing-stage at Jatoba, the up-river terminal of the Paulo Affonso Railway. As a considerable further expenditure is still necessary to make the river between Boa Vista and Jatoba navigable even for stern paddle steamers drawing only 13 inches of water, the anticipated traffic from the 2000 km. of navigable river above Boa Vista has never reached the Jatoba landing-stage.

Below Jatoba commence the rapids culminating in the Paulo Affonso Falls of the São Francisco which have a total drop, broken by a narrow midway shelf, of 260 feet, and a potential power reckoned at 500,000 H.P., or equal to that of Niagara. This break in the river's passage is covered by the 115 km. of the Paulo Affonso Railway, operated by the (British Great Western of Brazil system), but separated from the nearest railhead of this system by a gap of about 180 km. The total difference in the levels at the Paulo Affonso Railway terminals, on the Upper and Lower São Francisco, is 650 feet, and from the latter point there is a drop of another 26 feet to the river's mouth 50 km. distant. The Paulo Affonso railway is therefore in the curiously ineffective position of being cut off from the Upper São Francisco traffic by shallow channels, and of being physically disconnected from the coast system which operates it. Assuming both these defects to be overcome, we would have an inland rail and river connection between Rio and Pernambuco (whence rail connection is carried some 200 km. further north) made up as follows :—

Rio to Pirapora	rail	1006 kms.
Pirapora to Boa Vista	river	1204 "
Boa Vista to Jatoba (at present navigable by canoes only)	"	264 "
Paulo Affonso Railway	rail	115 "
Rail gap to Great Western of Brazil system	"	180 "
Great Western of Brazil lines to Pernambuco	rail	406 "
Total *		<u>3175 kms.</u>

The ocean passage from Rio to Pernambuco is 1050 miles, or 1690 km., so that the inland route as above would again be over double the sea service both in distance and in time.

* The project for uniting Bahia to Pernambuco by coast railways, passing through Aracaju (capital of Sergipe) and crossing the Lower São Francisco by train ferry above Propria, will probably be completed before the inland rail and river route given above is seriously reconstructed. The present gap between the Pernambuco-Bahia coast line heading south and north is some 600 kms.

We see that, owing to their greater length, together with the extra expense and the loss of time involved, the inland routes north and south of Rio serve at present local rather than through traffics. If by any chance, however, a hostile fleet were to blockade the Brazilian coast, their value would be more apparent, and one of the first military necessities would doubtless be a section of continuous railway bridging the gap between the Great Western's main system, centering in Pernambuco, and the long stretch of navigation on the Upper São Francisco River, as well as the finishing up of some 300 km. of the river's canalization in that portion leading to the Paulo Affonso Falls.

The *Madeira-Mamoré Railway*, like the São Paulo Affonso line (São Francisco River), the Tocantins-Araguaya line (Tocantins River), the Dorada Railway (Magdalena River), and the old East Argentine Railway (Uruguay River), bridges an impassable gap in the river navigation of the district. Its wide local influence, its political history, and its isolated post far within the Amazon Valley and its great forest, entirely cut off from any of the coast railways, make an account of the Madeira-Mamoré Railway equally suitable for beginning or finishing any review of Brazil's transport system.

The rapids of the Madeira River, which are covered by the Madeira-Mamoré Railway, mark the outlet of the ancient lake of Mojos, formerly occupying the Upper Amazon valley, whose waters drained into the Lower Amazon plain by breaking down the Parecis range of North-West Matto Grosso.* The Madeira reefs, nineteen in number, scattered along 460 km. of its course, account for a 476-foot drop from Guajara Merim, the upstream terminal of the railway, to Porto Velho, where it starts. The railway, which lies on the right bank of the river, measures only 364 km., and all but 7 km. are in Matto Grosso State. It can hardly be said to serve this State, however, its function being, as elsewhere stated, to connect the Lower Amazon basin with Eastern Bolivia.

The main affluents of the Madeira, nearly all occurring above the rapids, are the Inambará, Beni, Mamoré, and Guapore (or Itenez) rivers. All are majestic streams affording $3\frac{1}{2}$ feet navigation for some 2500 miles. They drain the whole Bolivian hinterland east of the Andes, except that part of

* See "South America: Outline of Physical Geography," *Geographical Journal*, 1901, by Colonel G. E. Church. It is a pleasure to record that Colonel Church's pioneer work in opening up the Madeira-Mamoré district is now fully recognized. "The old Collins engine (Baldwin), brought to San Antonio and put in service 4 July 1878, has been worthily named the 'Colonel Church.' Abandoned in that year when work on the road was stopped, it lay for a generation with the undergrowth rapidly climbing round it, until it was picked up on 20 April 1912 and brought to the Porto Velho shop. When discovered this veteran had a vigorous tree growing from its funnel. In spite of being apparently such a wreck, all missing parts were made for it in the Porto Velho shops, and the rejuvenated 'Colonel Church' was given a trial trip on 3 July 1912, with such success that it is to-day in constant service, and will haul its 300 tons over any part of the road. It is beloved and petted by the engineers as it thoroughly deserves" ("The Madeira-Mamoré Railway," *Pan-American Bulletin*).

Santa Cruz province adjoining the Paraguayan Chaco. Thus the country directly tributary to the Madeira Falls, that is, the area within which all traffic converges downstream upon the Madeira-Mamoré railway, in preference to attempting the Pacific route over the Andes, comprises about one-half of Bolivia. Adding to this some of the watershed from the Parecis range of Brazil and from certain portions of the Montana of Peru, we may take it that the total area which will immediately be influenced is probably not far short of 800,000 square km. (about 300,000 square miles). The Brazilian Government undertook to construct the Madeira-Mamoré Railway in return for the cession of 107,000 square km. of the Acre territory of Bolivia, *i.e.* a region about as large as British Guiana. The Treaty of Petropolis in 1903 further guaranteed an Atlantic outlet *via* the Amazon to all Eastern Bolivia. The railway remains the property of the Brazilian Federal Government, though leased for operation to a private company for sixty years. Before it joins the Madeira, navigation on the Beni River is checked by the Esperanza Falls; to clear this further obstacle it was agreed by Brazil that the Mamoré river should be bridged at Guajará Merim, and an extension of the present line, built entirely on Bolivian territory, be taken another 60 km. as far as the small town of Riberalta, at the confluence of the Beni and the Madre de Dios. This extension was begun, but construction is stopped during the war.

At Porto Velho, the rail terminus on the Lower Madeira, ocean-going vessels of 7000 tons can find good anchorage. From Porto Velho to its junction with the Amazon the main stream of the Madeira covers 1400 km. (870 miles). Manaus, the political capital and river *entrepôt* of all Brazilian Amazonas, lies about 100 miles up-stream from the Madeira mouth and 1000 miles from Para. Traffic, therefore, which comes over the Madeira Railway has yet some 2467 km. (1533 miles) to travel by the Amazon route before it reaches the Atlantic, but the saving in time and expense effected by the building of the railway makes this mileage of secondary importance. Formerly it took from four to six weeks to get by wearisome stages from the lowest rapids in the Madeira up to the Esperanza Falls of the Beni. Now the difficult Madeira portages are covered in twelve hours. Not only labour but life is saved, for it was reckoned that the river boatmen employed in running cargoes down and portaging up against the Madeira rapids, lost annually 25 per cent. of their total from accident and sickness.

As at Panama, the construction of the Madeira-Mamoré Railway, which was carried through by American contractors, was only rendered possible by utilizing modern sanitary science in fighting malaria, beri-beri, yellow fever, and other tropical diseases. In order to keep an effective working staff of 3000 labourers it was necessary to recruit a total exceeding 30,000 men in the five years between the commencement of construction in August 1907 and the inauguration of the line in September 1912. Problems arising from long or faulty communications, lack of local resources, the

obstacle of forest growth, insect pests,* rainfall and flood, in a word from the Amazon region and climate, had to be fought and overcome rather than serious engineering difficulties; and although the line has now been built the unending conflict with Nature continues.

The Madeira-Mamoré Railway is to-day the only recognized means of passage between two vast, incredibly fertile, and almost unpopulated tropical valleys, and its future prosperity will accurately reflect the progress of Bolivia's whole Amazon hinterland, a region still imperfectly explored and certainly unmapped save in the river reaches. Yet outside its low-lying rubber-lands this upper Madeira watershed is known to embrace an infinite variety of soil and climate. "All the upper branches of the River Madeira cross the almost level Mojos and Beni plains, which are the most inviting and healthy agricultural and grazing region of the Amazon Basin." Jesuit Missions controlling Indian colonies were early founded and still carry on their work in the districts between the Upper Guaporé and Mamoré streams. The slopes of the Eastern Andes, up to 7000 feet, were once described to the Royal Geographical Society as being "as beautiful as Paradise and almost as difficult to attain." The Madeira-Mamoré Railway has now brought at least the terrestrial alternative within the reach of every traveller in Amazonas.

The Madeira-Mamoré Railway is the loneliest railway in the world, more so even than the few miles of track built on the shore of the Magellan Straits. The nearest answering whistle to its locomotives as they traverse the Madeira's tropic banks would come from La Paz on the Bolivian Plateau, or from the Cerro de Pasco line on the Peruvian Andes, 500 miles away (as the condor flies) and $2\frac{1}{2}$ miles higher. The Madeira-Mamoré is more a strategic railway in every sense, geographical and political, than any other line perhaps in South America, and to its devoted staff working in that remote Amazon forest this fact is offered in the hope that it may be of some slight solace. The additional fact that this line, only 364 km. long, took five years to build and has cost nearly £5,000,000, is further offered for the benefit of those who light-heartedly contemplate similar pioneer enterprises in the Amazon valley.

Here for a time we must leave Brazil. Her transport problem is the most complex and interesting in South America. Her inland frontiers touch every South American State, excepting only Chile and Ecuador. Her mere bulk, greater than that of the United States, covers almost one-half of the continent.† It lies wholly within the tropics, none of it is desert, none even remotely approaches the snow-line, and almost all is below 3000 feet altitude. Nowhere else in the world has a nation at

* The Australian hardwood (Kauri) sleepers originally laid in the line were rendered almost useless within three years by the ravages of ants. They are now being replaced by native hardwoods immune from this scourge.

† United States (without Alaska)	...	...	2,980,339 sq. miles.
Brazil	...	...	3,218,991 "
South America	...	...	7,451,697 "

its disposal a land of such intense yet wasted fertility. Her distant provinces, ribboned by huge rivers, clamour for railroads to develop their vacant land and to connect them with the governing centre at Rio. But construction costs are high, the countryside is unpopulated, and almost every product they can offer from the interior will also grow within 100 km. of the seaboard. That under such conditions Brazil, relying almost entirely on a single great export—coffee—should have achieved what she has; that she should have encouraged foreign railroads without surrendering her freehold in the nation's transport; that she should have reconciled the local ambitions of her autonomous states with a far-seeing Federal programme and made active progress in realizing the same, is very much to her credit to-day.

URUGUAY

Uruguay has both a sea and a river coast, *i.e.* the Atlantic from its Brazil border down to Montevideo, and the freshwater frontage of the River Plate estuary which, together with the Uruguay River, forms its boundary with Argentina. The Bay of Montevideo occurs near the juncture of fresh and salt water, thus commanding the only watergate to the interior of the continent from the south. This advantage not only determined the site of the Uruguayan capital, but, until the recent construction of Buenos Aires' docks and the other harbours on the Argentine coast, gave it a paramount influence over all navigation seeking the Plate Estuary. As the political centre, the chief port and railway terminus of Uruguay, Montevideo has so strengthened its position that the numerous minor ports of the Republic, both on the Atlantic and fresh-water front, occupy an entirely secondary position.

In the sense that one line predominates over another, there are no strategic railways in Uruguay, every line built having practically the same object, *viz.* to open up the provincial departments behind Montevideo and to connect them with the capital. One feature of the Uruguayan service, however, is quite unusual in South America. Before the first constructions were embarked upon in the early seventies a connected railway plan covering the whole State was drawn up by Government, and this scheme has since been adhered to almost without alteration. The state programme inevitably took the form of a fan-shaped system radiating from Montevideo, with special developments along the western frontier facing the Plate coast and Uruguay River. The result is an excellent example of how political influence may shape a country's transport system, without involving actual State railway management. Practically all existing Uruguayan railways have been built under Government guarantees of interest, ownership reverting to the State, subject to certain conditions, after long terms extending in some cases to ninety years. Partly owing to British influence, partly to recommendations of the early Commission, all Uruguayan railways are of "standard," *i.e.* 4 feet 8½ inches, gauge.

This unique advantage is apparently quite unappreciated by the Government, which has not only refrained from specifying this gauge, but actually proposes a new system of State "narrow-gauge" lines.

Possibly the most important single line in the Republic is that portion of the *Central Railway* which, starting from Montevideo, connects at the northern frontier town of Rivera with the Rio Grande railways (*g.v.*) and thus provides through rail communication with the systems of South Brazil. Its value is less due to this international connection than to the fact that it traverses a well-settled portion of the country, sufficiently distant from both river and sea to adopt the railway as its only outlet. One must realize that the topography of Uruguay is very different in its details from that of the country surrounding Buenos Aires, with which it is sometimes confused. Uruguay's best lands, both agricultural and pastoral, lie on the coast fronting the Plate and the Uruguay Rivers. Here streams and creeks are numerous, the soil is well drained and very fertile, and the grasses "soft," *i.e.* fine *graminae*. In proof, the best wheat in the Plate is grown around Colonia (opposite Buenos Aires), while the cattle-products of Paysandau and Fray Bentos are household words. Behind this coast, however, and especially towards the Brazilian border, the black earth thins out over a succession of stony bosses, and "soft" camps are replaced by "hard," *i.e.* succulent pastures give way to coarse bunch-grass; agriculture is limited or non-existent; roads are rough and rocky, while their passage across streams is difficult and sometimes even dangerous. Near the Atlantic the contours are flatter, but the soil is sandy and cut up by numerous lagoons, which culminate in the Laguna Merim, an extensive inland lake. New railway extensions here are rare, for the proprietors cannot, as in the Argentine Pampas, push forward with the certainty that the output of the land will keep pace. In Uruguay both stock and crop fertility depend on a system of intensive or at least mixed farming, at present practically absent save near Montevideo and a few other points. The present railways meet the country's needs and reflect its advance, but such advance is slow.

The system ranking second in importance is composed of a number of small lines controlled by the *Midland Railway*. These lines, branching off the Central system, make for the banks of the Uruguay River and loop along it northwards, touching at the ports of Paysandau, Salto, and Santa Rosa (on the Cuareim River), which face their Argentine counterparts of Concepcion (limit of ocean navigation for large steamers), Concordia (below first rapids of the Uruguay River), and Monte Gaseros (above these rapids). The Midland lines also branch to Fray Bentos port, and by a bridge constructed across the Quarahim River, which forms at this point the frontier with Brazil, make possible an alternative route by rail from Montevideo to the State of Rio Grande do Sul.

The greater kilometrage involved, and the fact that the Uruguay River lines are built chiefly to assist local traffic, make it improbable that they

will ever compete for Brazilian service with the direct Central line *via* Rivera. If some cut-offs were constructed, however, and a train-ferry or bridge established across the Uruguay River at Salta or Santa Rosa, they might attempt to divert some of the Paraguayan traffics, which now go through Entre Rios to Buenos Aires. The Paraguay and the Argentine Railways in the provinces of Entre Rios and Corrientes are also built to the 4 feet 8½ inch gauge and given the above link could operate, should they so desire, over the Uruguayan lines. Indeed these systems (in which is also included the Central Argentine line along the Buenos Aires shore giving access to that capital) form the principal "standard-gauge" group, with 5706 km. out of a total of 8675 km., or 65 per cent. of all the 4 feet 8½ inch lines in South America.

The self-centred character of South American Republics is signally illustrated by the fact that there has been so little call for railway communication even between Montevideo and Buenos Aires, the two capitals most closely linked to each other geographically, as well as by social and business ties. The line from Montevideo to Colonia port,* which faces 28 miles across the River Plate to Buenos Aires, was only constructed in 1900. The through journey by combined rail and ferry could be easily covered in four or five hours, but most of the mails and passengers and all bulk traffic still use the excellent river boats leaving Buenos Aires and Montevideo daily, which churn up 124 miles of muddy Plate water in a leisurely night journey of eight hours.

In addition to its uniform railway gauge and its unwavering adherence to a gold currency, an outstanding feature of this small but self-reliant country is the socialistic, or to use an apter word, the communistic tendency of its Government, which of late years has only been prevented from assuming control of such complicated businesses as railways and insurance by lack of sufficient funds to buy out the present incumbents. Indeed, Uruguay suffers rather from over-government than from mis-government—a feature possibly influenced by the fact that out of its total population of 1,200,000 some 370,000 live in Montevideo. At the end of a long period of years during which railway mileage under foreign management, for reasons already noted, had shown very slow increase, a large number of State railway projects was recently passed by the Legislature, but still await construction. Recent legislation has further created a State monopoly of electricity for lighting, motive power, traction, or other purposes.

The rôle played by Uruguay to its neighbours is subordinate but not

* Colonia del Sacramento was settled by the Portuguese in 1680 as a counter effort to the growing Spanish settlement of Buenos Aires, and with one or two short intervals it remained Portuguese till 1777. From here foreign merchandise found its way, duty free, into the Spanish provinces of Buenos Aires, Tucuman, and Paraguay, and even to far Peru. To-day the picturesque little town, with its old bastions and buildings still extant, and a total population of about 3000 folk, serves as a favourite watering-place for the citizens of the Argentine capital.

dependent. The "Banda Oriental," as its citizens affectionately call it, is the only Republic in the Continent lying wholly in the temperate zone. It does not feel the influence of the Andes and the Amazon—those geographical tragedies of South America. Its climate throughout is excellent, running water abundant, and both stock and inhabitants singularly free from illness. Standing at the River Plate gateway Uruguay had the pick of early immigration to South America; hardy Italians from Lombardy, Portuguese and Spaniards of the seaboard, Basques from the French Pyrenees. The growth of foreign traffic and the building of international lines will thus probably continue to ensure appreciative visitors and a moderate progress to this fortunate little State and to its beautiful, but top-heavy, capital.

PARAGUAY

Apart from scattered industrial lines serving the quebracho (hardwood) industry of the Alto Paraguay River, the Republic of Paraguay has only one trunk railway—a melancholy distinction which it shares with Ecuador and the Crown Colony of British Guiana. This line, the *Central Paraguay Railway* originally laid to 5 feet 6 inch gauge, was planned to connect the capital and river port of Asuncion (1483 km. upstream from Buenos Aires) with the south-west region, or "Misiones," of Paraguay. Construction began in 1859, and Paraguay thus shared in the early railroad building which started at such widely divergent points in South America. Fifty years after this early start, however, only an additional 100 km. of track had been completed. This stagnation, remarkable during a period of exceptional railway progress elsewhere, is explained by the foreign policy of the Government, or more correctly, of the Dictators of Paraguay, who forced the country into a seven years' single-handed struggle with Argentina and Brazil, to which Paraguay forms a natural hinterland, and with Uruguay, whose port of Montevideo commanded its outlet upon the Plate. The outcome was a foregone conclusion, and, together with later internal troubles, definitely relegated the inland Republic to a background from which, chiefly owing to improved communications with her old antagonists, she is only now emerging.

The extension of the Central Railway south to the Alto Parana, where a train ferry now connects Encarnacion and Posadas ports, working on the same timetable as the Ibicuy (Entre Rios) train-ferry across the Parana Delta, gave Asuncion in September 1913 a through train-service with Buenos Aires. The immediate result to Paraguay has been not only improved traffics, but a notable influx of tourists and business men from Buenos Aires. The rail service between Buenos Aires and Asuncion takes fifty-two hours to cover a distance of 1524 km. (946 miles) made without break of gauge, for the Paraguayan construction included a change from the original 5 feet 6 inches gauge to the 4 feet 8½ inches standard of the Entre Rios lines. The new schedule compares with a former average of five days

by combined rail and river-steamer, or seven to ten days by steamer, according to the condition of the river. The present improved service by rail, and the increased attraction exercised by the Argentine capital, is diverting definitely to Buenos Aires the old-time monopoly of Paraguayan trade which Montevideo controlled by steamer and sail-boat service on the Parana River.

Old Paraguay, *i.e.* the territory lying east of the Paraguay River, has an area of 65,000 square miles. Its southern and eastern frontier is formed by the Alto Parana and terminates at the Guayra Falls and rapids, in whose potential water-power Paraguay thus holds an important if minor joint ownership with Brazil. Its northern boundary, entirely with Brazil, is partly the River Apa, a tributary of the Paraguay, and partly the Maracaju Hills. These outliers of the Matto Grosso highlands pass south through old Paraguay and finally decline, in its south-west corner, into a broken but pleasant country whose surface alternates in coarse pasture and scattered forest. Taking its name of the Paraguayan Misiones from former Jesuit Missions, it constitutes the most accessible, productive, and settled district of all the Republic.

Eastern or Old Paraguay is, as elsewhere noted, very similar to the southern portion of Matto Grosso. Their surface characteristics and their products are almost identical; their east and west frontiers are bounded by the same great navigable rivers.* The north-west railway from São Paulo, however, which terminates at Corumba, diverts Brazilian produce into an artificial west-to-east highway, while the products of Paraguay take their natural outlet southward, reaching the ocean *via* the River Plate. The downstream pull of the Parana and Paraguay Rivers, now assisted by the through railway from Buenos Aires to Asuncion, will probably be further reinforced in the near future by new railways extending from Santa Fé north through the Chaco. Lines on the Chaco shore already need only cross the lower reach of the Bermejo River to reach the Argentine frontier opposite Asuncion. Railways following this western bank of the Parana, and linked by a train ferry to Asuncion, although liable to periodic floods in the lowlands bordering the Bermejo and Pilcomayo rivers, would be capable of handling much heavier trainloads than on the Entre Rios route on account of their almost dead-level gradients, similar to those obtaining on the Santa Fé Pampas of which the Chaco is merely an afforested adjunct.

When both natural and artificial channels of transport lead south to the River Plate outlet, it is the more surprising to find a project which seriously aims at diverting Paraguayan produce eastward to the Brazil coast. A branch of the Paraguay Central Railway was recently built, about 170 km. south-east of Asuncion, to tap fresh forest land. An extension of this branch is planned up to the Alto Parana River, facing the outlet of the Iguazu River (170 km. south of Guayra Falls), with a further prolongation

* Subject, of course, to the break of navigation on the Guayra Falls.

on the Brazilian side to link up with the railway heading inland from São Francisco port (Sta. Katarina). The broken nature of the country, the obstacle of the Alto Parana River, and the existing competition to the south, make this line possible only as a State undertaking. The exports from this heavily-wooded eastern region, in both Paraguayan and Brazilian sections, are pine and cedar lumber and "yerba mate," of which characteristic South American beverage Argentina absorbs some 6000 tons per annum. Of far greater urgency to Paraguay, either from the industrial or political standpoint, would be a railway starting from the river-bank facing Asuncion and traversing the Paraguayan Chaco in the angle formed by the Pilcomayo and Paraguay rivers. Paraguay's Chaco boundary with Bolivia is still in dispute, but, however it is ultimately settled, it must form a base to the triangle of which these rivers form the two sides. Railways constructed here under Paraguayan auspices would strengthen the claims of Paraguay to a territory whose value is greater, inasmuch as it is more easily realisable, than that of any other region owned by the Republic. The extent of the Paraguayan Chaco has been variously estimated at from 50,000 to 100,000 square miles (the latter figure is given in the Paraguayan British Consular Report for 1912, by Mr. Oliver), according to the hopeful or pessimistic views taken by statisticians as to the result of the Bolivian settlement. At all events, Paraguay's Chaco territory will certainly equal, if not exceed, the area of Old Paraguay. This Chaco region contains excellent grazing grounds and extensive forests of virgin quebracho. It lies, moreover, in the line of any direct northern advance by the railroads of Buenos Aires, along the flat and fertile shores of the Paraná valley. The Paraguayan Chaco may therefore reasonably look forward to a substantial increase in land values long before any similar increment comes to the broken and heavily-forested portions of Eastern and Northern Paraguay, which can only plan railway extensions through difficult country to the cul-de-sac on the Brazilian border or on the Alto Parana River.

Paraguay has suffered not only from a troubled past, dating back to early Spanish occupation, but more recently from well-meaning but ill-advised accounts describing the country as a Paradise for the colonist. Living in Paraguay is certainly cheap if the settler is content to subsist on such tropical produce or stock as the country affords, but to produce for export is more difficult. The fiasco of the Australian colonists who settled in the Paraguay backwoods thirty years ago contrasts badly, for instance, with the success of the Welsh in Patagonia. The working of hardwoods and the yerba-mate groves becomes more costly each year, as exploitation is forced further into the interior. Cattle-raising is still the chief industry, there being between three and four million head of native horned stock in the country, but outside the Chaco Paraguay's best grazing land will not support more than 500 to 1000 cattle per square league. Sheep-breeding has proved a commercial failure, and horses are liable to troublesome kidney disease, which is probably

connected with tainted water. The orange traffic to Buenos Aires, however, has made great strides since the through-rail service was opened, nearly 18,000 tons of this fruit being sent south in 1915. Paraguay's few exports, therefore, are very similar to those obtainable in South-East Brazil and in Northern Argentina, with the drawback that they have to be transported some 500 miles further before reaching the ocean.

Nevertheless the interior position of Asuncion, lying far inland upon a big navigable river, gives Paraguay's capital a great if secondary importance when considered in relation to the coast ports and capitals. The only other cities in South America whose position and prestige are comparable to Asuncion are Manaus, 1000 miles up the Amazon, and Bogotá, whose high plateau overlooks the upper reaches of the Magdalena River, 700 miles from its Delta. If Paraguay will utilize to the full her commanding position as the inland junction of the great waterways of the River Plate basin, and will add thereto the exploitation of the extensive pastures still lying ungrazed within that basin; and if Asuncion can maintain itself as the chief *entrepôt* of all this interior trade, then the Paraguayan Government need not exhaust itself in premature efforts to force transport beyond its border. Railways from the seaboard will head towards Paraguay inevitably; first northward from the River Plate; later, in their proper sequence, by roads advancing inland from the Brazilian coast, or by mountain lines down the eastern spurs of the Andes, seeking to connect the low-lying and fertile Chaco with the barren plateaux of Bolivia.

ARGENTINA

Apart, perhaps, from the lines touching the frontiers of Chile and Bolivia, there are really no strategic railways in Argentina, that is, no lines whose services would, in an emergency, be indispensable to the State, as there are for instance in Brazil. It is unthinkable that any of the great Argentine systems, which are comparable in their extent and value to first-class American and English railways, should ever fail the public they now serve; yet if some impossible catastrophe were to blot out the rails of any single system overnight, it is certain that the work of repair and rebuilding would be undertaken next morning, just as in the forest when some great tree falls surrounding growths spring instantly to take its place. The reason is that throughout all Argentina the land has to-day a value and a production whose claim on transport is too serious to be disregarded, since the export of such products is a vital factor in the food-supply of overseas nations, and especially Great Britain. The following bulk tonnage of Argentine exports for 1913-14 reflects only a fraction of the responsibility and work laid upon the railways that handled it:—

	<i>Exports 1913-14.</i>
	<i>Gross tons.</i>
Agricultural products	9,067,785
Pastoral " 	748,687
Forestal " (principally quebracho)	463,648

(The above does not include cattle and other live-stock exported on the hoof.)

The bulk nature of Argentine produce and the absence of waterways render rail transport over her pampas a necessity. As a corollary, when the railway touches any section of land its value, hitherto largely dormant, is enormously increased. Thus the Federal Land Tax, based on periodic valuations and applied throughout the country, benefits in direct proportion to the kilometrage of lines. The special stake which both the Government and the Argentine citizen have in railway development is reflected in Table D, showing the rate of increase by decades during the past sixty years.

TABLE D.
Showing Increase of Argentine Railways by Decades from 1857.

Year.	Km. Total.	Actual increase (km.).	Ratio of increase.	Principal developments.
1857	23	—	—	First line laid (now incorporated in Buenos Aires Western Railway system).
1865	250	227	987%	Cordoba joined to Rosario port. Buenos Aires Great Southern Railway inaugurated. First rails laid in Entre Rios.
1875	1,956	1,706	680%	Inauguration of Central Argentine system and of lines extending into the "outside" camps, as well as along Plate shore. Railway built past rapids of Uruguay river.
1885	4,502	2,546	130%	Buenos Aires joined to La Plata, Mendoza and Rosario. Railways extended from Cordoba to Tucuman. Line built across Entre Rios from Parana to Uruguay rivers.
1895	14,116	9,614	213%	Railways extended from Tucuman to Jujuy. New Santa Fé line built to Tucuman. Development chiefly between Rosario and Buenos Aires as result of colonisation. First lines built into the Chaco along River Parana shore.
1905	19,794	5,678	40%	Buenos Aires docks finished. Transandine Railway opened to Valparaiso. Chief rail development south round Bahia Blanca and in south-west Pampas. Third railway extends to Tucuman. Line built from Monte Caseros (Uruguay River) to Corrientes, opposite Paraguay shore. Railway from Bahia Blanca across North Patagonia.
1914-15	36,531	16,737	84%	Entre Rios system joined to Buenos Aires and Paraguay by train ferries. Great increase in Central Pampa (alfafa) zone. State Railway system started in Patagonia and Chaco. Narrow and broad gauge lines begin to invade each other's territory, extending respectively due south and north.

Argentine railways are mostly owned and operated by private companies, chiefly British owned and managed, and it is a striking tribute to their efficiency that the Government has deputed to them in many

instances quasi-public works, such as the building and operation of docks, the carrying out of irrigation (this latter somewhat prematurely, considering the area of fertile land still unploughed), hydro-electric and water-supply schemes, colonization projects, the development of city suburbs and underground approaches, and the operation of grain elevators. Is it to be wondered that the railway bulks larger in Argentine perspective than elsewhere in South America?

Not only has Argentina a greater mileage of railway, both actually and in relation to population, than her sister Republics (see Table A), but in the province of Buenos Aires, where over half the tracks are laid, shows a density nowhere else approached over so extensive a district. The necessity of keeping fluid this converging traffic has reacted on Buenos Aires city, which is the first in South America to relieve the surface congestion of its streets by electric subway or "tube" railways. Argentine railways have already passed the initial stage, when their only object was to open up fresh territory; they are now competing, save in the outlying portions of the Republic, to hold that territory, and are further forcing intensive development of the land to provide themselves with traffic. The third stage, that of amalgamation, had already gone far, albeit somewhat checked by the Government's fear of monopoly interests. Chiefly for this reason State control over railways has of late advanced rapidly in Argentina. The Mitre Railway Law of 1907 obliged most of the lines to hand over 3 per cent. of their earnings (after allowing 60 per cent. for working expenses) for the improvement of cart roads and bridges within their zone. The same law however allows these lines to build extensions, not exceeding 75 km., from any existing portion of their track without applying for a fresh concession. This clause is important, since it permits the continuous growth by new construction of any system under its original charter, with consequent simplification of legal and parliamentary procedure, and, what is equally important, a great saving of time.

The most fertile as well as the most accessible lands in Argentina face the Plate Estuary. This fact made the city of Buenos Aires, at a much earlier date than Rio de Janeiro, the hub of all railway development within the Republic. The momentum gained by the capital is shown by its present population of 1,400,000, about one-sixth of the country's inhabitants. Political and social prestige, and a commercial growth greatly assisted by its newly-created port, combine to give Buenos Aires a compelling attraction not only within the Republic, but for all southern South America. Passengers and goods go *via* Buenos Aires, even at the expense of a longer journey, just as roundabout routes *via* London are often preferred in England, rather than shorter cross-country connections.

Although Argentina has already established through connections with Chile and Paraguay, and at more than one point has advanced her railways to the frontier of Bolivia and of Uruguay, such international service is perhaps of less value to her than to the States on the other side of her

long frontier line. The real importance of Argentina's railways to South America lies rather in the nation's wholehearted acceptance of rail transport, and the trumpet-call with which it has always proclaimed the message. "The locomotive has been the principal factor in uniting the Argentine Republic. . . . Without the railway the completion of its 100th anniversary would have marked but little difference from the completion of its 50th, and many South American states might never have completed their first century as nations. So convinced are we of this fact, that we believe that every South American country should raise a monument to George Stevenson, as one of the forefathers of its Independence." *

This declaration of faith is no theory: it is based on accomplished facts. The railway bound the northern cities to the Argentine Confederation; it wrought the true "Conquista de la Pampa;" it made the Bahia Blanca estuary, formerly as remote from Buenos Aires as the Straits of Magellan, a great and accessible ocean port; it broke the isolation imposed by the Parana River on the Entreriano provinces; it banished the terrors of the Chaco and found there a new and unexplored wealth; and now lately it is bringing into the lap of the River Plate all the untold increment of Patagonia. In colonizing new territory to-day the Argentine counts upon the mechanical aid of the railway, just as he counts upon his wire-fencing, his oxen, and his ploughs. As the maps show us, the railways have generously met his demand.

One of the principal safeguards for Argentina's unchecked rate of production (on which all else depends) is the diversity of latitude over which her produce is grown. Her extent from north to south is only exceeded by Chile, which of course has not her broad Atlantic pampas. It has hitherto proved impossible for any vagary of Argentine weather, even when combined with plagues of locusts, to adversely affect all of the three or four great staple crops grown over 2000 km. from the Chaco south to Chubut, or to entail equal losses among her cattle, sheep, and other live stock in a single season. If one staple fails here, it or another succeeds there. Yet although the different zones are now proved essential to the success of Argentina as a whole, their values were only discovered gradually as pioneer lines attacked and penetrated them in turn. It is thus the objective in each zone, rather than the individual railways, which we will now consider.

The North-West Lines.—Argentina's first two railways, the Western and the Southern, ran a few miles out of Buenos Aires and stopped on the bare Pampa, whose only inhabitants were roving Indian bands, wild horses and herds of long-horned cattle. The cities, however, notably Cordova, Tucuman, Salta, and Jujuy, where Argentine independence was fought and won, lay upon the northern route to Bolivia, the "lower Peru" of old Spanish

* 'El Primer Cincuentenario de Los Ferrocarriles Argentinos,' by E. Chanourpie. Revista Technica. No. 236.

viceroalty. The Declaration of Independence was signed at Tucuman city, whose province boasted a system of irrigation fed from the near Andean foothills. A later extension of this water-supply made Tucuman the principal sugar-raising centre of Argentina. The first penetration lines thus aimed at connecting Cordova and Tucuman with the nearest coast town, which happened to be not Buenos Aires but Rosario. The railways which later on pushed across the salt marshes and arid plains, to share in the produce from the "garden province" of Tucuman, assumed a risk hardly warranted either by the soil or the climate. Better sugar-cane can be grown, and without risk of frost, in Jujuy, in the northern Chaco, and more especially in Misiones, the only portion of Argentina comparable to the Brazil tropics.

Leaving Tucuman behind, the railroads proceeded to Jujuy, keeping the Andes on the west, and on the east the great Chaco, a formidable obstacle of afforested and nearly waterless* land, then inhabited only by Toba and Mataco Indians. The quebracho hardwoods of these forests, however, were found to be of high value for railroad sleepers and fence-posts, which the later settlement of the pampas called for in unlimited quantities, and their value was afterwards doubled by the discovery that quebracho extract could fill the large and growing gap in the world's supply of tanning material. Finally, as the quebracho forests were worked out or burnt off, no worthless second growth came up, but only excellent cattle-pasture. This last discovery has led, within the last twenty years, to a rapid settlement of the Chaco districts by railroads, sawmills, and in their track, colonists; a settlement comparable with the earlier rush to the southern pampas.

After leaving Jujuy city, the Government railway line rises rapidly up to 3442 feet, 10 km. of rack being used, and Argentine rails reach their north-western limit at La Quiaca on the Bolivian border. A gap of 200 km., now under active construction, passing through Tupiza, is required to bridge the distance between the (State) Argentine and Bolivian railway systems. This gap is at present covered by a regular but necessarily limited service of mail-coaches, used for passenger traffic only. When construction is completed the through journey of 2755 km. from La Paz to Buenos Aires should be made in slightly under four days, without change of cars if the Cordova Central Railway connections (laid also to 1-metre gauge) are utilized. This compares with about a week's journey at shortest, with many changes, from La Paz, the capital of Bolivia, by rail to Arica on the Pacific coast, by steamer to Valparaiso, and by rail again across the Andes to Buenos Aires.

An important spur of this *North Argentine (State) Railway* branches

* The term is used in respect of surface water only. In most parts of Argentina, and everywhere throughout the pampa formation, water has since proved easily attainable from wells.

eastward a little below Jujuy, and after crossing the Upper Bermejo River, at present stops at Oran. Continuing its way between the Andes and the Chaco forest for 150 km., the railway will cross the Upper Pilcomayo River into Bolivian territory. A further 500 km., much of it through open grazing-ground, and the rails would pass from the River Plate into the Amazon watershed at the town of Santa Cruz, the capital of Bolivia's 'finest lowland province, whence there is now combined river and rail connection with the Lower Amazon valley. Only the Madeira-Mamoré Railway has as yet remotely tapped this Santa Cruz district, a territory not only extensive, but capable of rapid colonization. Its grazing lands are similar but superior to those of the lower Orinoco Basin in Venezuela. Obviously, if south-east Bolivia is first opened up by railways advancing from Buenos Aires, its settlers will come not from the La Paz plateau or by way of the Amazon valley, but from the River Plate, a circumstance which cannot fail to greatly influence its future. The tentative routes towards this rich hinterland, of which we see to-day only the small beginnings, thus possess a very special interest.

Summarizing, we find the backbone of the north-west railways starting from Buenos Aires, touching at Rosario, their original and still their chief port, going through or round Cordova to Tucuman, and thence to the Bolivian frontier. To them is tributary, on the west, an undeveloped and almost unexplored mass of the Argentine Andes. Due north the rail connects with the Bolivian plateau. On the east the system sends out branch lines exploiting and colonizing the Chaco, some of whose produce, however, will naturally gravitate to the waterway of the Lower Parana and the local railways paralleling that river. Except for some recent extensions of the Central Argentine Railway, this north-western zone is entirely built to the 1-metre gauge, originally started with a view to economy in negotiating the distant Andes, but whose rails for the major part run through land as flat as any to be found in the southern pampas, which are monopolized by the rival broad gauge (5 feet 6 inches).

*The Entre-riano * System.*—The Mesopotamian provinces of Argentina form a rough parallelogram, bounded south and west by the Lower Parana and its Delta, on the north by the Alto Parana separating it from Paraguay, and on the east by the Uruguay River, which forms the Argentine frontier with Uruguay and Brazil. Surrounded by these great rivers, the provinces lie apart from the Argentine mainland, almost an island, save where north-eastern Corrientes, rising from the water-logged swamps of the Ibera Lagoon, merges into the uplands and forest-clad hills of Misiones. No other district in Argentina is at once so tempting and so difficult of access to railways. The Parana throughout its total distance of 1330 miles up to the Guayra Falls is, for practical railway purposes, unbridgeable. The anomaly thus early presented itself of some of the richest land in the Republic, nearer to Buenos Aires than Rosario itself, lagging twenty years

* This title is intended to include the province of Corrientes.

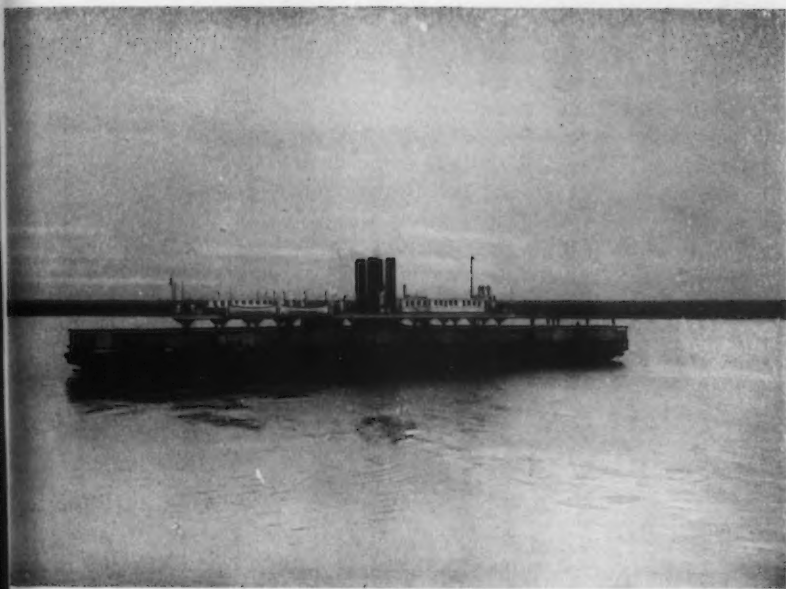
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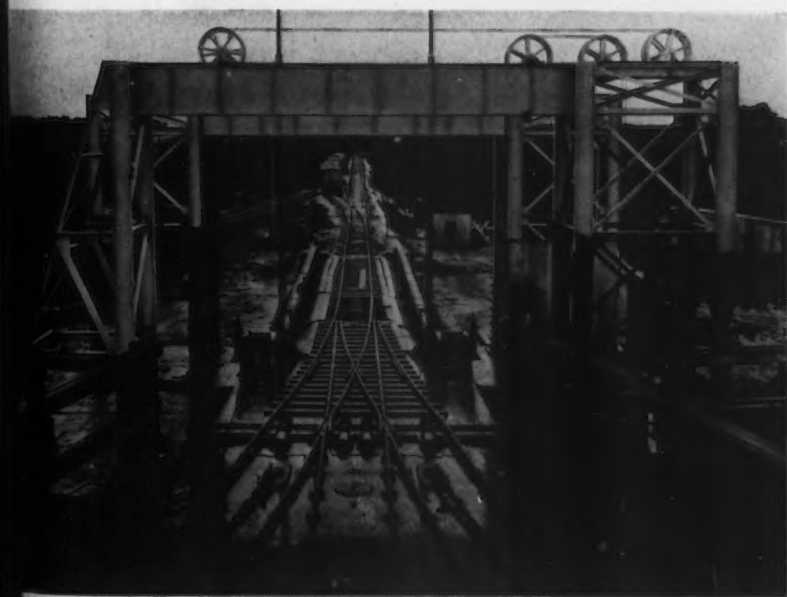
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TRAIN FERRY, IBICUY, DELTA OF PARANÁ



TRAIN FERRY AND CONNECTIONS, IBICUY, ENTRE RIOS



FOOTHILLS OF THE ANDES NEAR LAKE FOYAL, ARGENTINE, PATAGONIA



BRIDGE OVER RIVER NEUQUEN, GREAT SOUTHERN RAILWAY, ARGENTINE
PATAGONIA

IA

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behind the rest of the River Plate coast-line for lack of direct rail communication with the capital.

In 1866 the first 10 km. of rail in Entre Rios were laid from Gualeguay to Porto Ruiz, fronting a convenient backwater of the Delta. Four years later the Federal Government judged it a military necessity that Argentina should be able to concentrate troops on the Brazilian frontier and a second line, 153 km. long, was built from Concordia to Monte Caseros, past the lower rapids of the Uruguay River. This military venture has to the present day pinned the trunk railway system to the shores of the Uruguay river, an unfortunate location, since it not only competes with the local steamer-traffic, but crosses a number of troublesome tributaries near their outlet. A later extension, also built for military reasons, pushed across the water-logged northern province to Corrientes town, which commands the river approaches to Paraguay from the south.

Entre Rios Province, meantime, emphasized its freedom from Federal interference by planning its provincial railway-system, not from south to north, but from west to east, upon the "Cuchilla" or water-parting between its capital city of Paraná and Concepcion port upon the Uruguay. This location follows the highest levels of the deltaic formation which built up the Entre Rios Province.* In 1907, however, a line built across the "Rincones" or lower Delta lands, connecting by train-ferry with the Santa Fé shore and so with Buenos Aires, gave the island provinces their long-delayed train service to Buenos Aires. The former transverse lines have now become branch feeders of a north-and-south trunk-system joining Buenos Aires with Northern Corrientes. The logical consequence of this far-seeing scheme followed when the Corrientes lines were carried to Posadas on the Alto Parana River, and when, on the opposite shore, the Paraguay railway extended south to meet them. A second train ferry, which came into service in September 1913, furnished the international link. The breadth of the Alta Parana at Posadas is about 1500 metres, with a 10-foot maximum rise, but the actual ferry route is about 6000 metres. At the same date the Paraguay Railway altered its line to conform to the 4 feet 8½ inch Entre Rios standard.

These two train-ferries bridged the formidable obstacle to a continuous rail service which the Parana River offered in both its lower and upper reaches. They are solutions of a difficulty whose pioneer example throughout this whole region will be almost as valuable as its actual operation. Train-ferries were not new devices in 1907, but in South America prior to that date they had not been considered as a serious railway alternative to stationary bridge-work. Should later constructions carry the railway into the interior tropical valleys of South America, engineers will again be faced with river obstacles of a magnitude and difficulty unknown in any other continent. Then the Entre Rios-Paraguay rail and double train-ferry system, maintaining a continuous

* See "The River Parana," *G. Journal*, January 1909.

service between two capital cities across rivers fed by Brazilian rains and Andean snows, will provide invaluable data for engineers when some day they attack the last and greatest stronghold against railway advance, namely the Amazon Valley.

The Central Pampa Lines.—The railways which gridiron the Pampas of Argentina—or rather of Buenos Aires, for geologically the Pampa formation extends south to the Straits of Magellan—are built on land brought down by the Parana River at a time when its vast delta was moving from south-east Paraguay to its present site on the River Plate. The silt of the Pampean flood washed the feet of the Cordova range of Argentina, spreading as far as the hills of Curumalan and Tandil, south of Buenos Aires, before they settled in a diminishing sheet to their outlet on the Plate. The Central Pampas of our definition thus lie within a rough quadrangle whose boundaries go from Buenos Aires to Cordova; from Cordova to Villa Mercedes, about 700 km. due west of Buenos Aires; from Villa Mercedes as far as Curumalan on the road to Bahia Blanca; and thence back to Buenos Aires—an area roughly of about 250,000 square km., or, to use Argentine reckoning, some 10,000 square leagues.

The depth of this alluvial mass is amazing. A bore made by the Buenos Aires Pacific Railway at Laboulaye station, 500 km. west of Buenos Aires, passed for over 1000 feet through a uniform clay-marl-sand deposit before touching rock. There are many claims to the title "the richest soil in the world." The Darling Downs of Australia, the Canterbury Plains of New Zealand, the black-earth region of South Russia, the Nile Delta, the Mississippi bottoms, the Gulf Coast strip of Texas, the wheatlands of Manitoba—all have their advocates. In the light of statistics of stock raised and grain harvested, for the most part by unscientific methods and on land rented for short lease by tenant farmers, it is proven that none of these regions can rival the Buenos Aires Pampas for sheer capacity of production. Anglo-Argentine parlance acknowledges only two classes of "camp" or prairie, viz. "inside camps" and "outside camps." "Inside camps," situated on or near the coast, have short soft grasses, and with good management should support through the year one cow or three sheep to the acre, and in a good season double that number. Their cereal production is not here defined, for the Argentine landowner, despite his great cereal production, still thinks in terms of live stock. Travelling towards the "outside camps," *i.e.* those lying behind the coast belt, the proportion of black soil steadily diminishes, till at last only a slight chocolate tinges the sandy surface. The annual rainfall also shrinks from an average of 34 inches at Buenos Aires to 10 or 12 inches per annum round Mendoza, where the bunch-grass prairie calls for ten or even twenty acres to support a cow. The subsoil, however, a loose marl with abundant free lime, is uniform throughout. The western watercourses from the Andes meet this Pampa deposit and are almost entirely absorbed by it, or continue to the coast underground, their water-strata parallel to the surface of the level

ARGENTINE RAILWAYS IN 1880



ARGENTINE RAILWAYS IN 1911



plains but separated from each other by horizontal layers of hard-pan, or "tosca."

These "outside" pampas therefore, although superficially semi-arid, enjoy a system of natural sub-irrigation. The tapping of this system by the wholesale sowing of lucerne, or alfalfa, which began about twenty-five years ago, gave the "outside camps" a hitherto unsuspected value. Alfalfa roots in Cordoba soil penetrate 6 feet in the first year (they have been known to finally reach 65 feet), feeding greedily on the lime, till they pass the second and third water-strata, and thereafter become practically impervious to drought or neglect. In Cordoba province alfalfa pastures are grazed by stock throughout the year. If cut for feeding they give in seven summer months a total green growth of 12 feet to 14 feet, equal to 10 to 12 tons of cured hay per hectare. There are at present over 6,000,000 hectares, or say 60,000 square km. of alfalfa pastures in Argentina, by far the greater portion within this Pampa zone, while the sowing of new areas proceeds apace. As the plant is nitrogenous, the only form of soil renewal practised after cereal cropping in Argentina has been to sow alfalfa, a procedure which not merely renews the land's fertility but substantially increases its value. Without the use of alfalfa the present development in the Central Pampas would have been delayed another thirty years, as a glance at our Argentine railway map will confirm. Outside Buenos Aires city, wherever the railways west lie closest, there are found the best alfalfa "camps." Look however to the south-west, in the Argentine territory called "La Pampa." Here the nearest water is found 200 to 300 feet from the surface, and consequently alfalfa will not grow except in favoured patches. The railways that radiate out of Buenos Aires like spokes from the hub of a wheel stop short at this south-west rim. A similar line marking the limits of the alfalfa belt may be observed between Cordova and Villa Mercedes.

These pampa lands, devoid alike of natural obstacles or centres of population, gave the railways an almost free hand in choosing their route. Lines advanced from the River Plate shore to the "outside camps," halting for a brief interval to allow alfalfa pastures and ploughed lands to spread in their wake, and then resumed their advance for another hundred kilometres or so into the waste spaces. One such line, lately constructed, has as its official title "The La Plata and Fifth Meridian Railway," its final objective being the fifth meridian of longitude west of Buenos Aires. This title was chosen since its sponsors, the Provincial Government of Buenos Aires, apparently could find no other prominent feature in the landscape at that point. As in Canada, these pampa railways have not served towns; they have created them. All their traffics spring from the soil; and in the process "outside camps" have become "inside camps," while the former title is now more frequently applied to lands beyond the alfalfa belt, to the Chaco region, or to far-off Patagonia.

The lines of the *Buenos Aires and Pacific Railway*, leading almost

due west to Mendoza, are the Pampa section of the railway to Valparaiso—the only complete Trans-continental* line in South America to-day. The distance by rail between Buenos Aires and Valparaiso is 1438 km., or 894 miles, and the journey by mail-train is accomplished, if no blockage occurs on the mountain section, in thirty-six hours. The saving in distance over the sea route round the Horn is 2700 miles. The Transandine section, which was planned as far back as 1865, was only completed in May 1910, chiefly owing to the necessity felt, after the unnecessary and dangerous Patagonian frontier dispute with Chile, for a better and closer understanding with the neighbouring Republic, as witnesses that great joint monument, "the Christ of the Andes," erected on the Uspallata Pass through which the line runs.

It is in the Pampa district that the unprofitable rivalry between the railways of broad (5 feet 6 inch) gauge and narrow (1 metre) gauge is most hotly waged. The broad gauge claims a sort of natural aristocracy, having originated in 1855 on the *Buenos Aires and Western*, the first Argentine railway. Rolling stock for 10 km. (its total track) was ordered from England without specifying gauge, and a locomotive, destined for India but diverted to the Crimea for use before Sebastopol, was bought second-hand on its return to England, at a price suiting the despondent Western shareholders. The chance adoption of this broad-gauge, Anglo-Russian relic upon the southern pampas, and the almost equally casual purchase of 1-metre French gauge equipment for the lines laid further north, started a railway-gauge feud which is unending, since it is perpetuated by constant new constructions on both sides. The 4 feet 8½ inch or medium gauge in Argentina is happily almost entirely confined to the Entre Rios-Paraguay system. The futility of the special pleas advanced for either "broad" or "narrow" gauge are apparent when we look at the 400,000 miles of track operating on a uniform standard (4 feet 8½ inch) gauge in North America, from Canada down to Mexico City. The direct and indirect money loss to citizens of the Argentine Republic, resulting from the mixed-gauge evil, would go far to construct the 2000 to 3000 km. of new railway which are their present yearly requirements. It must be a chastening reflection to the administrations of these great and efficient Argentine systems that, with a clear field such as has been accorded to railways nowhere else in South America, and from lack of foresight and co-operation rather than owing to actual error, they should have allowed so artificial a barrier to have become so firmly implanted in the country. That similar, or worse, mixed-gauge blunders have been perpetrated in India, Africa, and Australia is an interesting but can hardly be a consoling fact.

The Southern Lines; the Ocean Ports; and Patagonia.—The outstanding features of the Southern Railway system of Argentina are, first the creation at various terminals of a chain of blue-ocean ports lying outside

* See "The First Transandine Railway," *Geographical Journal*, November 1910.

the Plate Estuary, with Bahia Blanca as the key to the whole; and further, the opening up of Patagonia, whose northern territory, through the late rail extension from Bahia Blanca, is now in direct touch with Buenos Aires.

The enormous output of the interior Pampas in the last fifteen years made the provision of ocean ports and terminals in the south a matter of great urgency. The approach to the Parana and River Plate ports of Colastine, Santa Fé, Zarate, San Nicholas, and other minor loading-stages above Buenos Aires, is controlled by a minimum 18 feet depth in the Martin Garcia Channel,* within the Plate, where the Uruguay current meets the silt brought down by the Parana. To avoid this a ship canal has been proposed, but is not yet constructed, along the Santa Fé shore from Buenos Aires to a point within the Delta. The silt brought down into the Plate by the Parana every twenty-two years is calculated to equal a cubic mile of solid matter, and its presence is seen in the muddied ocean waters far outside Montevideo. Buenos Aires port itself is being steadily enlarged, but its approaches need constant dredging to keep open a channel for vessels of even 26 feet, a fact which explains the rapid development of La Plata port, 30 miles further down the estuary, and of lesser harbours outside the freshwater Plate area.

The western boundary-line of Buenos Aires province is about equidistant from Rosario, Buenos Aires, and Bahia Blanca ports. Given equal rail-haul, the facilities for deep ocean vessels offered by Bahia Blanca over the two first-named has inevitably diverted the bulk of new tonnage from the Central Pampas southward. As we go farther west the advantage of the shorter rail-haul to Bahia Blanca becomes more clearly marked, and many new lines here in consequence already obey this southerly trend. As the best natural harbour between Brazil and the Straits of Magellan, outflanking the Plate and the Buenos Aires coast as a gateway from the ocean to the fertile interior pampas, Bahia Blanca is now assured of pre-eminence in the handling of Argentine exports. Since 1912 the wheat centre of the Republic has shifted from north to south, and to-day Bahia Blanca ships double the tonnage of wheat exported from Rosario, although the latter is still the premier maize port.

Thirty years ago Bahia Blanca was a shallow tidal estuary. To-day a port entrance has been dredged for ocean steamers up to 30 feet draught. The Government has established there its chief naval port and dry dock. The *Buenos Aires and Great Southern Railway*, which first recognized Bahia Blanca as the premier ocean port of the Republic, has reorganized the town's water-supply and continues its extensive terminals and port constructions. This company's own

* This is the figure given for normal depth on most official charts. In actual practice however the constant stirring of the soft muddy bottom by the keels of passing steamers has scoured a passage which is safe for vessels drawing up to 22 feet. Any cessation of the traffic would probably re-establish the former figure.

wharves and moles here can alone accommodate twenty-two ocean steamers at once. In this Bahia Blanca development work the Buenos Aires and Great Southern was later joined by the *Buenos Aires and Pacific* and the *Bahia Blanca and North-Western Railways*, all three leading exponents of the broad-gauge system in Argentina. The resulting increased outlet at Bahia Blanca, thanks also to active Government assistance, is a noteworthy help to exports throughout all Argentina, which were at one time threatened with serious port congestion. The Buenos Aires and Great Southern Railway also built and operates the South Dock of Buenos Aires port, with berths for twenty steamers. Harbour development in Southern Argentina is still in active progress. At La Plata important freezing and meat factories are established, and new extensions are being made to docks at Mar del Plata, better known in Buenos Aires as a summer resort, yet serving an important coasting trade. Port Quequen (near Nicochea), Patagones, and Port Madryn (south of Bahia Blanca) are developing along the same lines. As the efficiency of all railways is governed in the long run by the capacity of their terminals, this recent and continued activity in providing new outlets for Southern Argentina may be taken as a safe measure of the progress achieved throughout the interior.

There is a steady rise in the tide variation from the River Plate southward, so that a 2-foot tide at Buenos Aires becomes 45 feet and even 56 feet in the spring neaps at Gallegos, hard by the Magellan Straits. The coastal currents thus induced also set southward, forming sandbars across the few Patagonian harbours and river mouths. During its early process of up-building, the coast of Buenos Aires province was apparently subjected to similar influences. From La Plata down to Bahia Blanca the seaboard of the province is fringed by a broad belt of sand-dunes, inadequate drainage through which gathers any heavy rainfall back of the coast into brackish lagoons. Duplication of railway embankments further damming back the outlet leads in rainy seasons to extensive flooding, a situation somewhat relieved of late by an extensive relief canal system undertaken by the Government and focussing around Samboromb Bay. The country within this Buenos Aires-Bahia Blanca coast bight includes some of the Republic's best natural sheep pastures, as well as some good agricultural country. Of the 18½ million sheep which Buenos Aires province contains (Argentine Stock Census, 1915), the majority would be found in this "inside" district, where certain "camps" will stock ten or more sheep to the acre, till the ground becomes sheep-sick and is ploughed up to yield astonishing crops of wheat and linseed, and so "da capo."

The area under cereals has of late greatly expanded all round Bahia Blanca. The former expensive method of handling grain in sacks has been superseded by grain elevators both here and at Buenos Aires, and these will in time be duplicated at all the principal grain centres.

The Neuquen Extension.—The branch from Bahia Blanca due west to the Chilean frontier forms, with the northern lines to Paraguay, the most

interesting recent development of Argentine railways. This line links the alluvial pampas of Buenos Aires to the pebble-strewn plateaux of Patagonia, an arid bench-land between the Colorado and Negro rivers marking the boundary. The railway, which is operated under a Government guarantee by the Buenos Aires Great Southern system, reaches the Rio Negro Valley, Patagonia's northern frontier,* at Choel-Choel Island, whence it follows the river up to its Neuquen and Limay head tributaries. An important bridge across the former gave rail entry ten years ago to the Patagonian lake district of Neuquen, whose scenery, totally different to any hitherto within reach of the Buenos Aires citizen, earned it the title of "Argentine Switzerland." Nahuel Huapi Lake and streams, however, are duplicated many times in the succession of snow-fed lakes, rivers, and fertile valleys which lie between the Atlantic tablelands and the Patagonian Andes, all the way from Nequen to the straits of Magellan (see "Patagonia," Dr. F. P. Moreno, *Geog. Journal*, 14, Sept., Oct. 1899).

Leaving the big Neuquen bridge at the "Confluencia," the Great Southern line has gone to Zapala, 184 km. further west and is now well within sight of the main snow-clad Cordillera, which forms the Argentine-Chilian boundary and is distant 304 km. from the Neuquen river crossing. The Transandine crossing will be made near Pino Hachado Pass, where a surface location of under 6000 feet compares favourably with the long tunnel at 10,469 feet elevation on the existing railway from Buenos Aires to Valparaiso by the more direct Uspallata Pass, 600 km. further north. Passing beyond the Argentine frontier, another 126 km. of line would join railhead on the Pua Curacautin branch of the "Red Central," or Central (State) Railway system of Chile. The total gap between the Chilian and Argentine rails at this point is therefore some 246 km. From Curacautin, 209 km. over existing broad-gauge lines bring us to the important Pacific port of Talcahuano. This southern Transandine route thus necessarily connects with Chile's Longitudinal Railway system and its terminal port of Puerto Montt on the Chronos Archipelago, as well as with other intermediate Chilean ports. The gradients on the Pino Hachado-Pua Curacautin routes are moderate, and no rack sections need be used. The completion of this Andean section *via* the Buenos Aires Great Southern lines through Patagonia will therefore give South America its first transcontinental railway constructed without break of gauge (5 feet 6 inches) and operated by simple adhesion throughout.

A branch midway along the Bahia Blanca-Chile railway is planned to drop due south from the Negro or Colorado rivers in order to join the Patagonian coast again at San Antonio port (Gulf of San Mathias). State railway lines are already built towards the interior of Patagonia

* "Patagonia" is a purely historical definition. The Argentine region so described is politically divided into the three territories of Rio Negro, Chubut, and Santa Cruz.

from the ports of Deseado and Comodoro Rivadavia still further south. The obvious and most-needed construction, however, is a new trunk line from the Neuquen "Confluencia" south, running down the full length of Patagonia in the lacustrine depression lying in front of the Argentine Andes. A railway here would open up a region comparing favourably with New Zealand or the Alberta province of Canada. The hillsides of the Argentine Andes in Patagonia are mostly covered with a mixed pine and oak forest; the apple, descendant from old Jesuit orchards, grows wild, as do the strawberry and other numerous berries, while fuchsias grow 10 feet high. On the western tablelands, whose rising levels are cut by numerous "cañadones," or valley bottoms, running to the Atlantic shore, all stock, but especially sheep, flourish. A priceless asset to Patagonia is the splendid health enjoyed there by both man and beast, due to the dry climate, high summer winds, and cold winters, which combine to abolish all insect pests and equally all indigenous disease.

Patagonian lands, including the territories of Neuquen and Tierra del Fuego, account for about one-third of the Argentine Republic. They lie between lat. 38° S. and 56° S., that is to say, in a climate roughly corresponding to that which obtains from southern Spain to Edinburgh. The development of this splendid region offers to Bahia Blanca port and to its affiliated railroads an increment at least equal to that derived by Buenos Aires from its own fertile province. The first pioneers to recognize the value of Patagonia were British. Colonization in northern Patagonia dates from the Welsh Colony at Chubut. The first sheep farms of the south, in Tierra del Fuego and Straits of Magellan, were founded in the nineties by farmers from the Falkland Islands. Patagonia is already proving itself a great field whose new blood and energy are of inestimable value to the richer but less hardy settlements round Buenos Aires and in the north of Argentina. The sooner that a rail connection through these fine Patagonian valleys establishes a four-day journey between the Straits of Magellan and the northern Chaco, the greater will be their mutual benefit.

(To be continued in April.)

THE NORTHERN TERRITORIES OF THE UGANDA PROTECTORATE

The late Captain R. H. Leeke, Rifle Brigade

Map following p. 240.

NORTH of Mount Elgon and the Assua River, east of the Bahr el Jebel, and west of Lake Rudolf is a considerable tract of country which is but little known except to a few Swahili ivory traders.

Until four years ago the Uganda Government paid little attention to this country, but about then, having discovered that gun-running from Abyssinia had been going on for years and was getting serious, they began

to send up military patrols to stop this traffic and establish a semblance of order out of the chaos existing in the country.

The general formation of the country may be roughly described as follows: West of the Nile a rolling plain slopes gradually up eastwards until it reaches the escarpment which forms the Nile-Lake Rudolf watershed, where the ground drops abruptly into the Turkana plain which stretches eastward to Lake Rudolf. This escarpment is the most interesting feature in the country, and extends from south of the Turkwel Gorge round the eastern slopes of the Suk and Maroto Mountains to Morongole, where it reaches its culminating point and its crest is over 2000 feet above the plain below. Thence it extends round the eastern slopes of the Dodinga and Boya Hills, where it finally tapers off into the great plain stretching north towards the Pibor River.

In the plains both above and below this escarpment are several mountains and innumerable smaller hills, mainly of a volcanic origin. These mountains form prominent landmarks, as in most cases they rise straight out of the plain.

In the south-western corner of the area depicted on the map is the country inhabited by the Acholi tribe, who are now being administered by the civil authorities and have been sufficiently described by many previous writers. Their country is fairly well watered, and grain is in most parts extensively cultivated. The Acholi country extends northwards to Kiteng and eastwards to Mount Napono.

Near the south-eastern corner of the Acholi country are the Lopor Mountains. Inhabiting this range are two small tribes, the Tabur and the Nakwai. The Tabur appear to be a mixture between the Jiwe and Acholi stocks. They talk the language of the former and wear their hair after the same fashion, whilst their villages are similar in construction to those of the latter. These people are the chief spear-makers and iron-workers of the country; they make spears for the greater portion of the Acholi, and for the Jiwe, Koromojo, Turkana, and part of the Suk. The mountains abound with iron ore, and attract most terrific and alarming thunderstorms.

The Nakwai (or more properly Lakwá) live on the extreme eastern edge of the hills, and would appear to more nearly approximate to the Koromojo type, though they intermarry with and intermingle freely with the Tabur. It is possible that they are the remains of the former inhabitants of the Bakora plains who were overwhelmed by the Koromojo when they swept down from the north. They do not work in iron themselves, but act as agents for the Tabur for the purpose of selling their spears to the Koromojo.

South of the Lopor Mountains is the so-called "Lake Kirkpatrick," in reality a long narrow swamp, dry in the dry season, making one of a series of similar swamps formed by the confluence of the rivers coming from the north and east, and from which the River Assua finally emerges.

North of the Acholi country are several mountain ranges inhabited by small hill tribes. Description is rendered difficult owing to the fact that, whereas the natives invariably have a name for every peak and spur in a mountain range, they rarely have a name for the whole range or mountain. These mountains are chiefly of a precipitous nature, and often consist of a jumble of enormous granite blocks.

In the extensive range which for the want of a better name I will call the Laroma Hills (the Acholi name for it), a variety of small tribes are to be found. The Rom and Nangiya inhabit Mount Rom and the southern end of the Laroma range. These are of Dodosi stock and are great ironworkers, supplying spears to the northern Acholi, the Dodosi, and the Dabosa. In the centre of the range are the Lukuti of Acholi origin and the Napor, who appear to consist of a colony formed from various nationalities. On the north end of the Laroma Hills are the Bira, a small offshoot from the Dodinga and the Mayili, who to all intents and purposes are identical with the natives living on Teretenia mountain, and the Logira who live on the lower slopes of the great hill 20 miles to the north, shown on existing maps as "Egadang."

All these people wear their hair plastered with mud in the shape of an inverted bowl, which is often decorated with white beads or cowries. Their language is akin to that of the Koromojo, but varies slightly among the various tribes. For instance, the Logira have picked up many Latuka words, as have the Mayili from the Acholi. They build excellent huts, and their small villages are fenced with strong wooden stockades. They are mighty hunters, and are naturally of a brave and warlike disposition. They also cultivate extensively and have a fair number of small hill cattle.

On the top of Mount "Egadang" is a large and exceedingly fertile basin inhabited by a wild tribe, the Dongotono. These people, who are of a very low and primitive type, talk a distinct language and are of poor physique. They are treacherous by disposition, and are on bad terms with the Logira, constantly raiding their goats and cattle. They are armed with bows and arrows, but do not appear to poison the latter. They are said to be akin to the Immatong of the northern slopes of Mount Agoro, who have not yet, I believe, been visited by a white man. They are industrious agriculturists, and food is very plentiful. We ourselves were able to purchase over one thousand bags of grain from them in one year. They also cultivate a few bananas, which are practically unknown in Acholi Land and entirely so to the east, but which, I believe, are not uncommon amongst the yet unexplored tribes on Mount Agoro.

The origin of the Dongotono and of the manifestly superior Logira-Dodinga-Mayili stock would, I think, form an interesting study for an ethnologist. Amongst the latter people I have seen many with distinctly Hamitic features, especially the Logira. I am of opinion that they formed part of a Hamitic invasion from the north, which drove the aboriginals such as the Dongotono and Immatong into the hills. They were

then themselves, owing to inferiority in numbers, driven into the hills by the more numerous Acholi and Latuka, the Dongotono being again driven further up to the tops of the hills. They are probably akin to some of the tribes of the Boma plateau on the Abyssinian border.

West of Mount Egadang is the valley of the Kos River, which rises on Mount Agoro. West of the valley is a tremendous escarpment of cliffs called the Latuk Hills, over which in one place a tributary of the Kos falls sheer over 1000 feet.

It is noticeable that near this point the Dom palm replaces the Borasos palm, which is not seen north of this.

East of Mount Egadang is an uninhabited bush-covered plain through which runs the important watercourse of the Kidepo River, a dry sandy bed in which water can be obtained in most places by digging. This is a famous haunt for all sorts of game, and I have at various times seen the following species: elephant, rhinoceros, lion, leopard, chita, buffalo, eland, roan antelope, Jackson's hartebeeste, topi, lesser kudu, Grant's gazelle, giraffe, waterbuck, bushbuck, reedbuck, oribi, duiker, and diddik.

East of this plain are the Dodinga and Boya Hills. The Boya Hills have the same precipitous and fantastic shapes as their western neighbours; but the Dodinga Hills in the south consist of level ridges with a central plateau. The rolling plateau of Kimoto is over 7000 feet in altitude, with many running streams and patches of dense forests in which there is much wild rubber. These forests abound with *Colobus* monkeys, and it is said that the forest hog (*Hylocharus Meinertzhageni*) also lives therein.

The Dodinga are by far the most numerous and warlike of these mountain tribes, and can probably produce over 500 fighting men. They are armed with spears, both thrusting and throwing, and the usual oblong hide shield. They owned a large number of cattle up to four years ago, when a particularly bad epidemic visited them. They also cultivate extensively, and Matama and Mveli grain abounds. Until a punitive expedition was undertaken against them in 1913 they were in the habit of constantly raiding the Dodosi tribe. They are also on bad terms with their neighbours on the plain to the north, the Dabosa. The Boya are a smaller but practically identical people inhabiting the extreme north end of the hills.

From the Dodinga Hills rise the two principal Dabosa rivers, the Zingaieta and the Lotilleit. I unfortunately had no time to visit and trace the source of the latter.

South of the Upper Kidepo the country rises rapidly, and a similar rapid rise in level from west to east is visible in the plain south-east of the southern extremity of the Laroma Mountains. Thus the Dodosi-Jiwe-Koromojo country is a distinct plateau. This country is well known to traders, as the main route from Elgon to Abyssinia passes through it. The country is however now a closed district. It is a healthy country, but water

is scarce and is usually only obtained by digging in the river-beds, or is found in rock pools or Ngurunga as the Swahili call them. The northern portion of it is inhabited by the Dodosi Koromojo. This country is remarkable for the great quantity of small granite hills dotted about it. The natives own a large quantity of cattle and goats, the former being of the big humped variety common to the Koromojo and Turkana and of very fine quality. Much grain is also cultivated, especially in the north near the Morongole Mountains. The highest point in these mountains, called by the Swahili "Morongole Mkubwa," was ascended by Captain E. B. Hawkins, 4th K.A.R., who made the summit approximately 8300 feet above the sea.

South of the Dodosi country is that of the Jiwe, consisting of open cotton-soil plains. The Jiwe are a comparatively small tribe and are an offshoot of the Turkana. They are enormously rich in cattle. Owing to the entire absence of water near their villages during the dry months, the whole tribe treks west to the permanent water of the Zamugé (or Kapeta) River and to the foot of the Lobar Mountains. They sometimes penetrate right into the Acholi country, with the inhabitants of which they are on excellent terms. The Jiwe compare very favourably with their Koromojo neighbours to the south, who are a low treacherous type. They have always been friendly to travellers, and the fact that they have maintained themselves and more than maintained themselves for all these years, sandwiched as they are between two much more numerous sections of the Koromojo, speaks well for their fighting powers.

South of their country the plains are open as far as the Lokichari River. South and east of the Jiwe Bomas these plains team with *Oryx beisa*, eland, Grant's gazelle, hartebeest, zebra, topi, and ostrich. Out of this plain rises the waterless Mount Tororo, whose shape plainly shows its volcanic origin.

South of the Lokichari River lies the country of the Koromojo, the majority of whom have their permanent villages near the banks of the Natakalem River, whilst their flocks and herds wander about in the tract of bushy plain which extends to the Turkwel and Kilim Rivers. These people are divided into several clans.

The most prominent feature in the country are the great mountains of Debasian and Maroto, both over 10,000 feet in height. The former has been fully described by Major Powell Cotton, but has, I believe, never been ascended by a white man. The high portion of Maroto terminates on the eastern side in a stupendous cliff called Sogbeg, which drops absolutely sheer for some thousands of feet. South of Maroto are two lofty peaks by name Kachakalo and Kalapata nearly as high as Maroto, whose lower slopes are inhabited by small offshoots of the Suk tribe. As regards the origin of the Koromojo people I could obtain very little reliable information. An old chief, however, told me that when a boy (probably about fifty years ago) he lived on the Apulé River south of the Magosi

Hills. The Dabosa and the Koromojo were then one people, and their headquarters was along the Apulé River, where there used once to be an inexhaustible supply of water. Shortly afterwards, however, owing to the drying up of the water, the two tribes separated, the Dabosa going north to Zulia and Zingote, whilst the Koromojo, then a small tribe, moved south, where they half exterminated, half incorporated the local tribes, since when their numbers had largely increased.

There is now no permanent water at all in the Apulé River, as I have ascertained by digging over 20 feet at the old watering-places. A spring which always used to produce water twelve years ago, on the west side of Mount Tororo, is now completely dry, and there is much similar evidence everywhere that the country has been drying up.

The Koromojo still continued to graze their herds on the Moruasokar Mountains and as far as the upper Tarash River, until about twenty years ago they were driven up the escarpment by the Turkana, aided by a particularly bad epidemic of rinderpest. The Koromojo, Dabosa, Jiwe, and Turkana all talk the same language, which is practically the same as that of the Teso who live north of Lake Salisbury. The two former have always been at war with the two latter, who are generally lighter in colour and bigger in build, though otherwise they are not easy to distinguish between. They are all of magnificent physique and can travel vast distances at a stretch.

Captain H. A. Darley, who spent some years exploring the country to the north of the area depicted on this map, tells me that there are several places in Dabosa and the neighbouring country with names consisting of pure Masai words. These places are known to the Dabosa by these names, who however do not know their meaning.

Inhabiting the ridges of each side of the Lia Valley on the west side of Mount Maroto are a most interesting little tribe, the Tepeth. There is also a branch of them on Mount Debasian (in reality Tepethian) and also on the Suk Mountains. Major Powell Cotton gives an excellent description of them in his book. I obtained a small vocabulary of their language and compared it with the numerous vocabularies of native languages given in Sir Harry Johnston's 'Uganda Protectorate.' Their language did not appear to have the slightest resemblance to any language contained therein. They also talk the Koromojo language and are quite friendly now with them and also with the Suk. They appear to be more intelligent than the Koromojo. Their weapons are bows and arrows. On Maroto they own cattle, but on Debasian they do not.

Another tribe with a somewhat similar language, but who otherwise have little resemblance to the Tepeth, are the Teuso or Losioto, a small tribe who live on the slopes of the escarpment east of Morongole. These people are very primitive and live by hunting and by trading tobacco to the Turkana. They grow quantities of tobacco and do a great trade, Turkana even coming from the Turkwel to buy it. Below the great

escarpment the Turkana wander with their flocks and herds. They are entirely a nomadic people, though the old men generally have their headquarters near some permanent water. They own large quantities of cattle, a fair number of camels, and enormous numbers of goats and sheep. Grain cultivation, except near the Turkwel and Lubur Hills, is practically unknown. They are big men as a rule, though I have never seen justification for the fabulous stories of giants related by many writers. I should say that the Jiwe and Dodinga were both taller races.

The Moruasokar Hills are continued northwards by the Longolechom and Pelegech Mountains. Permanent water in these hills is plentiful, and in the dry weather they are much used by the Turkana. The most noticeable point about all these mountains, and also of most of the small hills, is that they are tilted up in the same direction as the escarpment, viz. from west to east, *i.e.* they slope up gradually from the west and end abruptly in precipitous bluffs on their eastern sides. The Moruasokar Mountains are cut up by tremendously deep gorges formed by the many watercourses which feed the Tarash River. This river has forced its way through a gorge in the north-western foothills, and emerges on the plain as a sandy watercourse about 100 yards broad. Near lat. 4° N., however, it begins to spread over the plain, which becomes a morass in the rains. Hereafter its bed is only noticeable in places. The Nakolale, coming round the north of Pelegech, and the river-beds from Zingote and Mogila also empty themselves into the plain. In heavy rains all this water runs north under the name of Nanam. Some Turkana say that after exceptional rains this water has been known to reach Lake Rudolf. Information about this is however very vague. It is certainly hard to imagine however that the enormous quantity of water which comes down the Tarash after heavy rain can be entirely absorbed into the ground.

North of Pelegech and about 35 to 40 miles from it is another considerable range of hills called Kasirin (the Donyiro of the Swahili caravans), which is marked on no map that I have seen. I had no time, unfortunately, to visit these hills or opportunity to fix their position.

East of the Moruasokar and Pelegech is a desolate bush-covered plain, waterless for most of the year, and a cotton-soil morass after rain. There is however a practicable route from Pelegech to the Turkwel, south-east down the Kagwalathé River. A fine view of the country to the east and north can be obtained from the summit of Pelegech, which we ascended. This includes the Lubur Mountains, and far to the north Moruakipi ("the mountain of water"), Koroma, and the Abyssinian hills.

The country between the Moruasokar-Pelegech Hills and the escarpment, and also in the vicinity of Mounts Zulia, Zingote, and Mogila, is remarkable for its numerous salt or brackish springs. These are generally found in the most barren spots near the foot of the hills. Those near the eastern base of Zingote are the most remarkable. They are very strong and of a very dark blue colour. These vary greatly in quality, and

it is possible to drink the water from one spring whilst that of another a yard or two from it is quite undrinkable. These brackish springs are called by the natives "Neruzi," and the word is almost certainly the origin of the "River Ruzi" marked on the old maps, as springs are often found in river-beds, and the river at that place would be called "Neruzi." The so-called Lorusia Mountains at the north-west end of Lake Rudolf are, I am told, misnamed from the same reasons.

BRITISH AND METRIC MEASURES IN GEOGRAPHICAL WORK: NOTES FOR DISCUSSION

Arthur R. Hinks, M.A., F.R.S., Secretary R.G.S.

Read at the Afternoon Meeting, 14 December 1916.

THE conjoint Board of Scientific Societies are about to consider the desirability or otherwise of pressing for the compulsory use in the British Empire of the metric system of weights and measures. It will therefore be appropriate that each society should consider from its particular point of view the merits of the case for and against the abandonment of the British system.

In considering the particular requirements of Geography we shall find it convenient to proceed by way of the general considerations governing not only scientific work proper but the orderly conduct of all operations requiring measurement and calculation. Some of these considerations may first be stated briefly.

Since we are irrevocably committed to the decimal system of arithmetic, and it is hardly possible that we should change to the far more adaptable duodecimal system, it is obvious that any system of units with strict decimal relations will have certain great conveniences. On the other hand, any decimal system of units will have all the disadvantages arising from the limited divisibility of ten into integral parts, neither a third nor a quarter of ten being a whole number. These disadvantages are much more serious in the simpler affairs of life than they are in scientific work and its more refined applications to industry.

A decimal system is not necessarily the metric system of units. Nor is there any necessary advantage in having units of the same kind, of weight for example, decimally related among themselves. The want of a decimal relation between tons and grains is rarely a source of inconvenience. But it is a real advantage to use only one unit of weight—ton or pound or grain as may be most convenient—on a given operation, and not to employ a complex of units not related decimally, as in giving a weight in tons, quarters, hundredweights, and pounds.

It is of great importance that the unit in any given operation should be

of a size convenient in that operation, involving neither waste of figures nor habitual substitution of some fraction as the unit. The metric tonne and the British ton, not very different in size, may be taken as of established convenience. On the other hand the kilogram is not of a convenient size for trade, or it would not have been replaced in common use by the half kilogram under different names.

There is a fundamental difference between measuring, making to measure, and buying or selling to measure. The first requires for convenience a decimal system of units, or rather a unit decimally divided; the second is more and more conducted by gauges and templates and regulated by standard sizes of material; the third requires a unit of convenient size with binary subdivision to halves and quarters.

There is a fundamental distinction between multiplicity of units of different names, perfectly determined and standardized, and confusion of units of the same name but different actual size. The first prevails in the British Empire; the second prevailed in France before it established the metric system about 1792, and in Germany before its adoption in 1871.

Comparisons between incommensurable standards cannot be of the highest precision. In work of refinement and complexity it is well to use units based on the standards most completely studied and most conveniently related. This is true of original work of all kinds. When processes become standardized for production on a large scale by assistants who have to work by rule, the growth of technical literature and tables does much to mitigate any logical inconvenience in the bases of the process.

The unit of length is more involved in the past than any other unit, both because of the establishment of all kinds of standard sizes and fits, and because the natural appreciation of measures of length seems to be easier than that of other units, perhaps from more frequent exercise.

In the above statements of principle we have taken the examples from weights because the units of weight are of less importance in Geography than the units of time, length, and angular measure, and we run less risk of prejudgment, the examples being for illustration only. If the principles are accepted, at least provisionally, let us see how they affect our particular science and its applications.

It will be convenient to begin with the units of time and of angular measure, which are intimately related, and on which there is little difference of opinion. The year and the day are necessary units fixed irrevocably by nature, and incommensurable. The one historic attempt to divide the year and the day decimally was an historic failure, and there seems to be no disposition anywhere to repeat the experiment of changing the units of time, though its uniform measure has recently been interrupted.

The measure of angle is closely related with that of time, and a decimal division of the circumference would for that reason have many disadvantages. Its sole advocate is a Mexican engineer who has published extensive tables which I suspect no one else has ever used. Moreover

the principles of trigonometry demand that the quadrant and not the circumference shall be a unit, so that a decimal measure of angle receives at the outset a serious check. The decimal division of the quadrant is used by the French Service Géographique de l'Armée, but not by their Navy nor their astronomers, nor now, I think, by any one else in the world. When their eight-figure logarithm tables were the only eight-figure tables in existence it was occasionally necessary to transpose astronomical and geodetic calculations into this system for work of the highest precision; but eight-figure tables in the ordinary system are now available. An undoubted convenience in the addition and multiplication of angles is to be set off against an inconvenience in size of the decimal subdivisions of the quadrant, which do not fit very well with the limits of achievable accuracy in instruments of practicable size. As there is no apparent disposition to urge the universal use of the decimal division of the quadrant, no more need be said on this point.

If the degree is to remain as a unit of angle, with its sexagesimal division into minutes and seconds, it seems inevitable that the nautical mile shall remain in navigation. It is a bad unit, indeed impossible for precise work, because it varies with the latitude, and a long distance expressed in nautical miles has no exact meaning. Its use should probably be confined rigidly to navigation, and geographers should express long distances uniformly in statute miles or kilometres. The need for great accuracy in the expression is happily not common, and the delicate questions involved in the definition of the geodetic distance between two points need not detain us now.

There is no doubt much to be said for the retention of the fathom on its merits, as a unit convenient in size for the recognizable marking of the line, though the method of dealing with fractions: "By the deep—Nine," or "And a half—Seven": is perhaps more picturesque than systematic. But by the geographer the fathom should not be used, and sea depths should be expressed in the same units as land elevations.

This brings us to the question of the unit for the representation of heights, both for spot heights and for contours. The British unit for heights is the foot—never the yard or the mile; and so long as it is a question of representing individual heights the familiarity with the foot might make us chary of using the metre. At any rate conversion tables are easily to be had when they are wanted. But the unit for the vertical interval of contours is quite another matter, since contours in feet cannot be converted into contours in metres with any accuracy—at least without going over the ground. This, then, is not a case in which it might be argued that a man may work in any unit he likes as long as he expresses his results in the standard notation. There are here strong reasons for concluding that all new work should be done in metres, and that all reductions of old maps contoured in feet should in the process of generalizing for the smaller scale be converted into metre intervals. Our experience in the production of

the 1/M sheets has taught us the extreme difficulty of combining material contoured in metres, feet, Swedish *föd*, and Russian *sajen*.

The conclusion that British maps should be contoured in metres whenever possible involves the most difficulty and requires the most careful consideration. If it be objected that we cannot bring ourselves to think in miles for lengths and metres for heights, we may notice that the relation of the foot to the mile is not more simple than that of the metre to the mile, for purposes of mental comparison. We are accustomed to use two distinct units for the two measures, and their relative sizes do not materially affect us. We may also remember that contours are used less for the determination of numerical heights than for the representation of the shape of the ground; while if on a map contoured in metres it is desired to estimate slopes as one in so many, it is easier to do it by the scale of horizontal kilometres which should be attached, than to do it with contours in feet with the scale of miles.

In the choice of the unit of length for maps there is little difficulty, since every map can be and should invariably be provided with a scale of kilometres as well as of miles or of versts. It matters nothing to the geographer, and perhaps not very much to the surveyor, if he works in feet or in metres, provided always that he shows the metric scale on his finished sheet. The tendency to use the so-called natural scale is already so prevalent even in non-metric countries that it is unnecessary to insist on its advantages. There can be little excuse for starting any really new series of maps on a scale with an awkward representative fraction. But more or less new series are so usually dependent on an engraved original that a change of scale in the standard maps of the Ordnance Survey or the Survey of India would require a generation to accomplish if the metric system were made compulsory to-morrow.

The question of the unit of length to be employed in geographical writings is more difficult. Were the metre, as it was intended to be, the ten millionth part of a quadrant of a meridian, it is perhaps doubtful whether any sensible convenience would result, in view of the total indisposition of mankind to adopt the decimal division of the quadrant, added to the fact of the considerable ellipticity of the meridian, which renders the relation between differences of latitude and distances along the meridian by no means simple. Since in fact the metre is one part in five thousand different from its design it is a standard just as arbitrary as the yard, and in that respect no better. But it is used in the statistics of a considerable part of the civilized world; and when a country attempts to discard its local measures it is almost certain to adopt the metric system and not the British, so that the balance of use is on the whole likely to grow against us. While we retain our British system in common use it is pedantic to expect the geographer to use kilometres in his common descriptive writing. But it might very well be adopted as a principle that the more elaborate, more statistical, or more technical his

work, the more should he be encouraged to work in the metric system, or at any rate to give his results in both systems if he cannot discard the old. This is especially desirable in treating of countries where the metric system is in use. For example, in a statistical paper on the railways of South America it should not be considered necessary to translate all the official data into miles for the benefit of the British and North American readers. On the other hand, it might be allowed in description to say that El Misti is only a few miles from Arequipa.

Such a principle leads straight to the conclusion that all new geodetic work and tables, and all new tables for the projection of maps should be in the metric system. These matters are for the relatively few. Geodesists work with a large number of significant figures, and demand the highest precision in the comparison of standards, which is much facilitated if they are all in terms of the same unit. It is a curious fact that the Ordnance Survey ten-foot standard bar cannot be compared with the highest attainable accuracy either with the standard metre or with the British standard yard, since it is not a multiple of either. The use of the British Imperial yard is defensible. Even if it had its origin in the length of arm of King Henry I. it has been practically a constant since Elizabethan times, which is more than can be said of the unit of length of any other country. All the more strange, then, it must be accounted that all our geodetic work has been done in feet.

With units of area the geographer has little trouble. The square mile is good enough for him, and square kilometres would do equally well. He rarely uses acres; but if he does will naturally follow the Ordnance Survey in using acres and decimals of an acre, not acres, roods, and perches. In this connection it is interesting to note that Gunter's chain of twenty-two yards, divided decimally into one hundred links, and making ten square chains to the acre, is the only British measure with conspicuous decimal advantages; and that the British have shamefully misused it. They habitually say 5 chains 44 links instead of 5.44 chains. Having arrived at a result in decimals of an acre they, excepting always the Ordnance Survey, convert it into a complex of acres, roods, and perches. And finally, they very commonly, especially on railways, use chains and links for distances which are not required for measures of area.

Units of weight and of volume concern geographers so little that there is no need to discuss them here.

To sum up the propositions which I would put before you as a basis for discussion:

All British maps should be provided with scales of horizontal distances both in miles and in kilometres; heights and contours should as far as possible be in metres, both on land and in the sea. The representative fractions of all British maps should as far as possible be in round numbers.

In work relating to countries which use the metric system, and in

statistics, results should be given in British and metric, or in metric alone, but not in British alone. The more technical the work, the more desirable is the use of the metric units. In British geodesy the metric system exclusively should be used for the future.

If the above uses of the metric system are established in British geographical work it is unnecessary to press for the adoption of the metric units to the exclusion of the British units.

Finally, I should like to make a suggestion on the method of expressing the representative fraction of a map.

The expression of the scale of a map by its representative fraction requires a large number of figures, and a quick mental comparison of two maps is not so easy as it might be. For example, the "one in two hundred and fifty thousand Africa" is a mouthful of words; and even if abbreviated to the "two fifty thousand Africa" it is still cumbersome. The quarter-inch to the mile Great Britain is even less convenient when spoken of as the "one in two fifty three thousand four forty."

I would suggest for consideration an alternative method of writing representative fractions, which might perhaps with advantage be used, at first in addition to the ordinary method. Take the fraction " $1/M$ " as a unit; express the representative fraction of all maps on a larger scale than $1/M$ as a fraction with M in the denominator and the proper numerator— $1/125,000 = 8/M$, $1/63,360 = 15.8/M$, and so on.

The representative fractions of maps on a smaller scale than $1/M$ would remain as they are, except that the denominator would be expressed in M 's, that is to say, $1/1,680,000$ would be written $1/1.68M$.

It seems to me that this system of describing the scale would be of considerable use in cataloguing and indexing maps, as it is concise, and gives one the relation of the scale of any map to what will, we hope, become the standard of reference, the International Map of the World on the scale of $1/M$. It is suggested that this method of representation should be given a trial by using it as an alternative to the ordinary form, that is to say, that in the title of a map we should write the representative fraction " $1/125,000$ or $8/M$." For convenience of printing and for legibility it is desirable to write the fraction always with the solidus, $8/M$ instead of $\frac{8}{M}$.

Table of Common Representative Fractions.

$1/750,000$ or $1.33/M$	$1/100,000$ or $10/M$
$1/600,000$ or $1.67/M$	$1/80,000$ or $12.5/M$
$1/420,000$ or $2.38/M$	$1/63,360$ or $15.8/M$
$1/300,000$ or $3.33/M$	$1/62,500$ or $16/M$
$1/253,440$ or $3.94/M$	$1/50,000$ or $20/M$
$1/250,000$ or $4/M$	$1/40,000$ or $25/M$
$1/200,000$ or $5/M$	$1/30,000$ or $33.3/M$
$1/126,720$ or $7.89/M$	$1/25,000$ or $40/M$
$1/125,000$ or $8/M$	

Before the paper Dr. MILL (in the chair) said: The Conjoint Board of Scientific Societies has raised the question of the desirability of pressing for the adoption of the metric system in the United Kingdom; and the subject is one that has of course frequently been considered before by this Society and by other societies for special purposes. This afternoon we are fortunate in having a very clear statement of the whole case drawn up by Mr. Hinks, which will form a basis of discussion, and without saying anything more I will ask him to give us an account of what he has put together.

(Mr. Hinks then read the paper printed above, and a discussion followed.)

Dr. MILL: I think you will agree with me that the author has put this subject before us in an extremely thorough and lucid way. When in 1899 I made a proposal that for future geographical work the metric system should be used, I was actuated by a desire simply to ensure uniformity amongst the work of geographers of all nations. The convenience of some of our British units is undeniable. Their sizes are in all cases more convenient for practical purposes than the units of the metric system; and we have been so long accustomed to these units that we have in our heads certain relations between them that simplify a great many of the difficulties caused by the complexity of the system.

But we have now before us the important scientific question of how reform can be carried out; to what extent it should be carried out at once; and whether we should proceed with it before waiting for a compulsory introduction of the metric system—supposing that should ever come, as I think it is extremely probable it will come. In chemistry and physics the metric system has been in use for, I suppose, forty or fifty years. I shall ask those present who have something to say on geographical measurements especially to give us their views, and I shall first call upon Captain Keeling of the Egyptian Survey.

Captain KEELING, R.E.: During the last eighteen months I have had a good deal to do with French geography and with French tables and maps, and may say that I have found the centesimal division of the right angle immensely superior for the ordinary geographical work which a surveyor has to do when he is not concerned with astronomy. It is convenient in the use of tables, particularly in looking out long distances; and is especially convenient in interpolating in the tables of logarithms of the trigonometrical functions. Secondly, I would mention a curious thing which we have come across in German practice. The German artillery use neither the usual system nor the metric system; but they divide the circle into 288 parts. We have captured large numbers of their war maps and of their metal protractors which they issue, and all I have seen have been so divided. But the question I should like to ask is why Mr. Hinks is so keen about putting heights and contours into metres. It seems to me that the only advantage is the rapid calculation of slopes, which is a rare thing to do in ordinary life; and I do not think that a rapid calculation of slopes would anything like compensate for the confusion of introducing into general maps—and the map is becoming more and more an article of general use—a unit which people are not familiar with. I quite agree that if there is a general metric system, then of course the metre can go on to the maps, so long as the foot is allowed to be used in other walks of life, such as engineering, where I think it should be retained.

Mr. REEVES: The subject with which we are dealing to-day is one of considerable interest, and we have to thank the author for the clear manner in which he has brought it before us. The metric system came into existence in

France at the time, if not as a result, of the French Revolution, when radical changes were too readily accepted; so there may be some excuse for our tardy adoption of it in this country. There is no doubt that a decimal system of some kind has many advantages; and as the metric system has pretty well established itself, and is gradually becoming more commonly used, in time to come it is probable that we shall fall into line with other countries.

As a matter of fact, without any Government action or parliamentary decree, we are of necessity becoming increasingly compelled to adopt the metric measures in order to take advantage of the scientific work of countries where they are used. Just recently we have had to prepare a map at the Society in which a selection of spot heights had to be given from French documents in which they were in metres. Our rule has been to give heights in feet, and the metres were converted accordingly. But it was then found that contours indicating the depths of the surrounding ocean were required as well; and as on the best charts these contours were in metres we were obliged to keep to metres; for if we had attempted to draw contours in feet or fathoms by interpolation we should probably have been led into serious errors. But we could not show the heights of land in feet and depths of the surrounding water in metres, so we had to put the spot heights back again into metres.

For several reasons it might be a mistake to propose too drastic measures at once; but it is generally admitted that for all scientific purposes the metric system should be adopted in this country without delay. For geographical work I am inclined to think that the suggestions of Mr. Hinks would meet the case for the present. It might be advisable to give equivalents in miles, feet, or fathoms for some time to come, but as a rule this is cumbrous, and it would, I hope, gradually cease to be necessary as people became better able to think in the metric system.

It may be well to remember that although we keep to the old system of degrees, minutes, and seconds, yet attempts have been made in this country to take advantage of decimal divisions in another way. For example, in the Ferguson Percentage Theodolite, by dividing each octant of the horizontal circle into one hundred parts representing equal divisions of the tangent of 45° , ordinary traversing is greatly facilitated.

Mr. E. G. C. BARTON admired the paper for its calm philosophic attitude, especially enjoyable after his experience of the bitter animosity of the "sacred inch" enthusiasts; but he failed to see the beauties of duodecimal and binary divisibility, because in actual practice folks asked for half and quarter pounds, in spite of the binary division which gave them the choice of saying "eight ounces" or "four ounces."

As to the nautical mile, the author's despair of its being altered was a sad commentary on the so-called practical methods of a great commercial nation; and it was therefore quite a relief to find him determined to fight that other geographical monster the fathom. The speaker had been working on estuaries and sandbanks recently and could testify to the annoyance arising from the use of two units, feet for river depths and fathoms for the sea. It was thus a pleasure to hear advocacy of the metre for contours and heights, above as well as below the water. It is regrettable that the Admiralty charts refer to "Low water spring tides" as datum, which renders the altitudes of a sandbank in the Severn incomparable with that of a bank at Bristol on account of the dissimilarity in range of tide. The suggestion to write $4/M$ for 1:250,000 is excellent, as it gives a much improved mental picture.

While the author expresses belief in the unsuitability of the Metric System

to daily wants, it is comforting to note that he recognizes that the balance of use is likely to grow against us. His final conclusions are still more cheering in that he, with his knowledge of the requirements of the geographer, recommends that the metric system should in most cases receive equal consideration with the British, while in case of more technical work (especially in Geodesy) he advocates its exclusive use. The author's advocacy of such a measure being applied to geographical work is the more remarkable in view of his unwillingness to see the metric system inflicted on the rest of the community. This is especially interesting to one who has met great commercial organizations which advocate the suitability of the metric system to the nation at large, but claim exemption for their own particular business.

Mr. W. S. BARCLAY: As I have recently submitted a Paper to the Society which combined measures of miles and kilometres in distance, metres and feet in altitude, I am perhaps asked to join this discussion as a first offender. My reason, however, was not ignorance; it was merely the desire to put the figures in front of different people in the manner each can best understand and appreciate. There is precedent for my case. British-managed railways in South America conduct all their local operations on the metric tables, but present their shareholders and Boards in England with statistics carefully worked out in miles and English tons. While for use in higher circles—statistical and others—the metric system alone is probably of advantage, yet at the lower levels dealing with the work that common people must understand, the method advocated by the lecturer of giving metric equivalents for local measures seems to me the most practical. I do not think that some people realize how local measures, especially of distance, have sprung from the soil as it were, and how strong is their hold. For instance, the popular measure of distance in South America is not the kilometre or the mile, but the league. The length of the league varies with locality, and the reason for this is that it was never a measure of distance, but represents the distance travelled in a given time. Such local measures are surprisingly accurate in their application. In Brazil the league is shorter than in Argentina because the ground is more broken and it takes longer to get from point to point. While in favour of the metric system, I would ask uncompromising advocates to remember that they are faced with the passive resistance of the three most conservative classes of people in the world, the seaman, the farmer, and the housewife. I think the best present use of the metric system is that which can be paraphrased in the terms in which Adam Smith spoke of money, as an international standard of values and as a medium of exchange for local systems.

Captain HENRICI, R.E.: As I very much regret to say that I did not hear the paper I cannot add much to the discussion. On the Ordnance Survey we have practically converted our measures into a decimal system, and the ordinary detailed survey is all done by the chain, divided into 100 links. We never write areas in acres, roods, and perches. We never work distances in miles or yards or anything but feet and decimals of a foot, which means a great saving of time. I would add only one point, that in a mountainous country like Switzerland it is always the custom to measure a journey in hours and not in kilometres.

Mr. HINKS: There are several questions on which I should like to have more information, especially the very interesting fact mentioned by Captain Keeling that the Germans use 288 as the governing number in the division of the circle. Has he any idea what 288 means?

Captain KEELING: No, we have only the obvious fact that it is so; what the origin of it is we do not know—at least, I believe we do not know.

Mr. HINKS: I was hoping that Captain Keeling, who has lived for many years in a country which uses the metric system as fully as any, would tell us how in actual practice he likes the metric system. Do you find it comfortable to work with?

Captain KEELING: In scientific work generally, as well as in the Survey of Egypt, we use the metric system, with one exception; our areas are always expressed in the old unit, the feddan, which has been in use for a good many hundreds of years. All our actual survey is done in metres, but when we come to marking up plans we convert to the feddan. On the general question of the decimal system in the country, I am enthusiastically against the decimal system pure and simple. About four years ago we reorganized a series of measures in Egypt, and I had a good deal to do with the starting of the service. The legislators of the country were divided into two camps, and by far the larger camp was one which advocated the decimal system. It was largely composed of Egyptians who had spent some time in Paris on their summer's leave, and I think their decision was given without consideration. It was a decision of the Committee of Legislative Assembly in Cairo. After a lot of trouble—it took two or three years, in fact, to get the thing settled—we decided to stick to what had been the system for the last twenty or thirty years in writing, and previously in practice. It follows what I believe to be a universal trait of the human mind—that one multiplies decimally and divides duodecimally. The ordinary man invariably thinks in tens when he is multiplying, and in halves, quarters, and twelfths when he is dividing. Our system of weights and measures in Egypt is a most delightfully simple one. We do not have 112 lbs. to the hundredweight. No man in his senses would support that. But we have taken the pound as a sort of general weight, which we divide into 12 ounces, and that again into 12 drams. We multiply decimally, and 100 lbs. equals one hundred-weight. For the common uses of life, for the housewife and so on, I am certain—so far as it is not conceded to say that one is certain—that that is the system which eventually the world will get down to.

Mr. HINKS: We are fortunate in having such an interesting speech from Captain Keeling. I had not any idea that recently in Egypt their system had been revised, having always looked upon Egypt as a place where they used the metric system, and so when I sent a copy of my remarks to Captain Keeling I said, "You will probably come and disagree with me." I am delighted to find that he does not. The reason why I should wish to use the metric system as much as possible for heights and contours is that the International Map and our own I/M map do so. We ought to look upon all fresh mapping with an eye to its incorporation in this scheme; and unless a map is originally contoured in metres one loses much in time and in accuracy.

Now I should like to break a lance or two with our friend Mr. Barton over some of the things he said. He thought it was too detached a policy to deal with ourselves alone as geographers, and not to consider the advantage of ordinary people; that if we proposed to use the metric system ourselves we should come down and lend a hand in this great enterprise that he has at heart. For my part I do not in the least believe in the metric system for ordinary purposes; and if he says we must fight either for or against, I would fight against, and very strongly against making the metric system compulsory. As to his regret that there is, shall we say, an indisposition to adopt the centesimal division of the quadrant—and he doubts there being any such indisposition—I can say only that the French Hydrographic Office, the French Observatories and all the large number of the scientific institutions in France,

have for a century lived accustomed to the sight of the centesimal system in use by the *Service Géographique de l'Armée*, but no one of them has adopted it, and none has shown any tendency to do so. Finally, in reply to Mr. Barton's well-worn contention that British weights and measures are responsible for two years' waste of time in our schools, I would suggest that any waste of time is due to bad teaching, and that the two years must be spent upon arithmetical exercises of some sort, for which a complex system is not disadvantageous.

Captain Henrici has spoken of the use of the chain and the decimals of an acre in the Ordnance Survey. We must not forget to give due praise to Gunter for this admirable system, one of the few good pieces of decimalization in our practice.

In conclusion I ought to say that I had prepared my notes without reference to, and indeed in ignorance of, the excellent paper on the subject read by Dr. Mill at the International Geographical Congress of Berlin in 1899.

Dr. MILL: I must now sum up this discussion, which has been the most interesting we have had for some time. You will wish to express your thanks to the reader of the paper, and to the enthusiasts for and against, who have spoken out of the fullness of their hearts.

THE RELIEF OF SHACKLETON'S ROSS SEA PARTY

Dr. Hugh Robert Mill

ON the return of the *Aurora* to New Zealand in March last it became known that ten men of the Shackleton expedition had been left in the Antarctic in May 1915. Of these four were at the winter station at Cape Evans, and six under the leadership of Captain Mackintosh had not returned from their expedition southward on the Barrier; but it was hoped that they were safe at Hut Point. Sir Ernest Shackleton's fate with the Weddell Sea party was unknown, and as immediate steps had to be taken if the Ross Sea party were to be rescued this year, the British, Australian, and New Zealand Governments undertook the organization of a relief expedition. The British Government contributed half the cost, the other half was borne by the Commonwealth and New Zealand Governments in proportion to their respective populations. The *Aurora*, seriously damaged as she had been in her long drift in the ice, was the only ship available. On survey she was found to be badly hogged (*i.e.* forced up amidships), the stem and stern were seriously strained, and a large amount of her sheathing needed renewal. An Australian committee was formed in Melbourne, consisting of Rear-Admiral Sir William Cresswell, Prof. Orme Masson, Captain J. R. Barter, Commander Stevenson, R.N., and Dr. Griffith Taylor, to whom we are indebted for much of this information. They worked in conjunction with Mr. J. J. Kinsey of Christchurch and Mr. John Mill of Dunedin. Mr. Kinsey, whose experience with the final equipment of the earlier Antarctic expeditions gave him unique advantages in superintending the fitting out, gave his whole

time to the task, and the *Aurora* after being put into thorough repair at Port Chalmers was ready for sea early in December. The command of the relief expeditions was offered by the Governments who had undertaken it to Captain J. King Davis and accepted by him. His fine work, first as chief officer and then in command of the *Nimrod* on Sir Ernest Shackleton's first expedition, and again in command of the *Aurora* on Sir Douglas Mawson's expedition, is well known. He was supported by a number of his old subordinates. Sir Ernest Shackleton was fortunate in being able to reach New Zealand in time to sail with the *Aurora*, and he was to be responsible for any land operations that might be necessary. It was highly probable that Captain Mackintosh had gone south again this season in the expectation of meeting Sir Ernest Shackleton on his way from the south pole; if so he could not return to the base before the month of March. In that case it would have been necessary to send a search party, involving the risk of another wintering.

The *Aurora*, provisioned for two years, left Port Chalmers on 20 December 1916, and made a remarkably rapid voyage, reaching Cape Evans on January 10. Here seven of the ten members of the expedition who had been left behind in 1915 were found and rescued. Unhappily Captain Mackintosh and V. C. Hayward had lost their lives in a blizzard which broke up the sea-ice while they were on the way from Hut Point to Cape Evans on 8 May 1916, and shortly before the Rev. A. P. Spencer Smith had died of scurvy on the Barrier. The remaining members of the party were taken on board and the *Aurora*, leaving McMurdo Sound on January 19, arrived within wireless range of Wellington on February 5, a remarkably fine achievement.

A detailed telegram from Sir Ernest Shackleton appearing in the *Daily Chronicle* of February 12 enables us to give a brief account of the work of the Ross Sea party. Cope, Jack, and Hayward, forming one of the southern parties, got back to Hut Point on 14 March 1915, three days after the *Aurora* had gone to seek winter-quarters, and on the 22nd Mackintosh, Wild, and Joyce arrived. They had laid two depôts on the Barrier, one at 79° S., the other at 80° S. Of the sixteen dogs of the first party two survived, but all of Mackintosh's party had died. It was June 1 before the six men were able to reach Cape Evans over the sea-ice, and by that time the *Aurora* had been blown away. The winter passed without incident, and on September 1 sledge journeys with stores to Hut Point were commenced. The work was very heavy as only four dogs remained. On 9 October 1915 three parties of three men each started sledging stores southward from Hut Point to the Bluff depôt in 79° S., and after making four journeys between these points the whole party started south to lay out the remoter depôts on which Sir Ernest Shackleton's expected party would depend for their existence. Three men, Jack, George, and Cope, were sent back from 80° S. as their stove was worn out, and they reached Hut Point on

15 January 1916. Mackintosh proceeded southward with the others and on January 22 at 83° S. Spencer Smith broke down with scurvy, and was left in the tent with provisions while the others pushed on to Mount Hope (near 84 S.) and laid the last dépôt there at the foot of the Beardmore Glacier on January 26. The return journey was a terrible experience. Scurvy attacked one member after another, and Spencer Smith had to be hauled on a sledge from the beginning, while on February 17 when within 30 miles of the point where Scott perished the whole party were kept in camp by a blizzard for six days until their food was exhausted. Notwithstanding the weather they made a start in the faint hope of reaching a dépôt 11 miles away; but Mackintosh fell exhausted, and was left with Spencer Smith, and Wild to look after them, while the others struggled to the dépôt and returned with food and fuel. They started again on February 29, with Smith and Mackintosh lashed on a sledge, and next day Hayward also had to be added to the load dragged by the others. Progress was hopelessly slow, so to save the others Mackintosh insisted on being left behind in a tent while the others pushed on. Spencer Smith died on March 9 after forty-seven days' illness, cheerful to the end. Two days later the survivors reached Hut Point, and returning for Mackintosh brought him in on 18 March 1916. They had fulfilled their mission, laid all the dépôts, and travelled 1500 miles over the Barrier. The invalids speedily recovered with fresh food, and on May 8 Mackintosh and Hayward started to cross the young sea-ice to Cape Evans, but were never heard of again. Two days later the rest of the party found the tracks of the two pioneers stopped abruptly by open water. Every search was made; and eight months later Sir Ernest Shackleton landed at several points from the *Aurora* and searched the coast for relics, but found none. Mackintosh had perished like Scott, his work well done; but happily most of his party survive.

From all the facts which are now before us we can form a fair opinion as to the success of the expedition as a whole. It is obvious that as a trans-continental journey it has completely failed, because no landing-place on the Weddell Sea could be reached. There are consequently no results as regards the geography of the unknown portion of the Antarctic continent across which Sir Ernest Shackleton hoped to make his way. We have long urged that an exploring survey of the whole of the accessible coast of Antarctica from the sea is a necessary preliminary to any inland exploration from new coast bases. This desideratum remains, and when Antarctic exploration is resumed we hope that it will take the form of a cruise in the highest attainable latitude from Queen Mary Land westward to and if possible beyond Coats Land; and another from the neighbourhood of Alexander I. Land westward to King Edward Land. Possibly a favourable opening for land journeys may be discovered in this way. While a failure from the point of view of fulfilling a programme, Sir Ernest Shackleton's attempt cannot have failed to produce results of importance.

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CAPTAIN FREDERICK COURTENAY SELOUS, D.S.O.
Royal Fusiliers, Frontiersmen Battalion

Phot. by Weston





The observations on the *Endurance* in her push to the south and on the *Endurance* and *Aurora* in their respective drifts to the north should produce, when published, new facts as to the ice-movements outward from the Antarctic circle. The Weddell Sea has been traversed along a new line with important bearings on the interpretations of earlier voyages; and the meteorological observations made on both sides of the continent must add materially to a branch of knowledge the practical importance of which to the people of the southern continents is becoming plainer every year. The greatest interest, however, attaches to the renewed proof that failure due to physical causes served only to throw into relief once more the magnificent courage, tenacity, and comradeship of the British explorers. Mackintosh's devotion to his disabled companions and his choice of the place of greatest danger for himself is a worthy companion-picture to Shackleton's heroic struggle with winter and frozen seas in rescuing his men on Elephant Island. They all lived up to the noblest traditions, and we rejoice that so many came through in safety.

CAPTAIN FREDERICK COURTENAY SELOUS, D.S.O.

AS briefly recorded in the February number, Captain F. C. Selous has been killed in East Africa while gallantly leading his men to the attack; and yet another African explorer of note has thus fallen a victim to the war. Two friends who knew him well have written for us appreciations of Selous' achievements in Empire-building and in natural history; these we print below, but must preface them with some connected account of his strenuous career, and especially of his important contributions to our knowledge of the geography of South Central Africa—a region now incorporated in the British Empire largely through his adventurous doings. The nature and extent of those contributions can be well understood by a reference to the publications of the Society during the period of his most active life in South Africa, records of new and fruitful journeys having appeared in most of the volumes issued through a long period.

Frederick Courtenay Selous was of French and English extraction on his father's side, English and Scottish on his mother's. Born in London on 31 December 1851 and educated at Rugby, Neuchatel, and Wiesbaden, he was only nineteen years old when he started for South Africa, bent on making a living as an elephant hunter. In 1872 he set out on his first serious expedition into the northern interior, then to a large extent virgin ground for both hunter and explorer. Making his way to the court of the Matebele chief Lobengula, whose goodwill it was necessary to secure, he after some difficulty obtained the necessary permission to hunt elephants in the remoter parts of the chief's dominions, to which most of the herds had then retreated. Selous quickly became noted

for courage, skill, and endurance in pursuit of his calling; and in course of time his wanderings led him far afield into parts of the northern region into which no white men had yet penetrated. In 1877-78 he pushed beyond the Zambezi into the heart of its northern basin, occupied by the feeders of its great tributary the Kafue or Kafukwe. Crossing the Zambezi some 80 miles east of the Victoria Falls, he followed the little-known north bank of the river past the great Kariba Gorge, and crossing the Kafukwe near its mouth climbed to the elevated Manica Plateau, traversing this to the north-west until brought up by the great marshes of the Lukanga River, where the illness of his companion—a Mr. Owen—compelled a return. It is interesting to recall the indirect connection between this journey and a famous work of fiction, for it certainly suggested to Rider Haggard the location of the surprising adventures of his three heroes in 'King Solomon's Mines,' their plunge into the unknown having been made from a point which exactly tallied with Selous' "farthest." Other journeys of value to geography were those to the region of the Chobe or Linyanti, which did something to elucidate the complex hydrography of this river and its relation to the system of Lake Ngami; and one to a little-known part of Mashonaland (*Proceedings R. G. S.*, vol. 3, 1881, pp. 169, 358).

In 1881 Selous returned to England, for the second time only since his first arrival in South Africa, and in the same year brought out the first of his fascinating narratives of hunting, adventure, and travel under the title 'A hunter's wanderings in Africa.' It met with an enthusiastic reception and established its young author's reputation as one of the most daring and successful hunters of the day. Returning to the wilds in 1882 he resumed his explorations in Mashonaland and continued to send the Society his valuable narratives and route-maps for publication in its *Proceedings*. Much new light was thereby thrown on the hydrography of the southern tributaries of the Zambezi, as well as on the headwaters of the Sabi flowing direct to the Indian Ocean. The general results of his various journeys in Matabeleland and Mashonaland were shown on a sketch-map in the *Proceedings* for May 1888, in which the red lines representing his routes formed an almost complete network over the country. In his reports he constantly drew attention to the value of these elevated regions for settlement, and thus helped greatly to arouse an interest in these countries and eventually to secure them for the British Empire. In 1883 the Society's Council awarded him the Cuthbert Peek Grant in recognition of the value of his geographical work, and he was encouraged to fresh efforts by the award of the Back Grant in 1889. In 1890 he placed his unique experience at the disposal of the British South Africa Company, and performed perhaps his most important service by leading the Company's pioneer expedition to Mashonaland, thus finally substantiating Great Britain's claim to that region against possible rivals. With great energy he undertook the construction of a road suited to wheeled traffic and thus supplied a much-needed means of access to the new territory,

pending the construction of a railway. He also took advantage of every opportunity of improving the map of Mashonaland.

In 1892 he was once more back in England, and at a meeting of the Society in February 1893 gave an account of his 'Twenty Years in Zambezia,' published in the *Journal* for April of that year, with a map showing the whole of his extensive routes in that region. In the same year he received the Founder's medal of the Society (which he joined as a Fellow in 1894) and also brought out his second instalment of African experiences: 'Travel and Adventure in South-East Africa.' He returned to Mashonaland and helped to suppress both Matabele insurrections, during the second of which—he having meanwhile married a daughter of the late Canon Maddy and settled in South Africa—his homestead was burnt by the rebels. These experiences were described in his third book, 'Sunshine and Storm in Rhodesia' (1896).

Selous's wanderings were by no means over, but in future took the form mainly of hunting and ornithological trips to various parts of the world—Asia Minor, the Rockies, Newfoundland, Alaska, etc. When in 1909 Mr. Roosevelt undertook his sporting expedition to East Africa, Selous was entrusted with the task of organizing the party, which he himself accompanied. Before this he had brought out his fourth African book: 'African Nature Notes and Reminiscences' (1908), in which, besides much interesting matter on the habits of the African game, he entered somewhat fully into the problem of protective coloration.

On the outbreak of the war Selous, whose bodily and mental vigour showed no signs of impairment, made an urgent claim for military employment in the continent he knew so well. Some demur at his age was overcome by the doctors' report that it was impossible to refuse a man of such magnificent physique, whereupon he was gladly accepted. He had joined the Legion of Frontiersmen in 1914, and on the formation from the Legion of a battalion of the Royal Fusiliers in March 1915 he was given a commission as lieutenant in that battalion, being promoted Captain later on in the same year. In September 1916 he was awarded the D.S.O. "for conspicuous gallantry, resource, and endurance."

E. HEAWOOD.

The great heroes of the past have needed no material monuments to keep their memories alive; their fame has been their best and most lasting monument. It is not too much to say that the deeds of Selous as a principal actor in the romantic drama of the occupation and settlement of Rhodesia will never be forgotten so long as the Rhodesian spirit survives in that great domain which the genius of Cecil Rhodes has added to our Empire. The writer of this tribute to a very great sportsman and very gallant gentleman recalls a saying of Cecil Rhodes that a name placed upon the map is a monument for all time. So far the trace of the famous Selous Road has not been recorded on the map of Rhodesia. It is to

be hoped that occasion may now be taken to rectify this omission. The story of the advance along that road of the small pioneer column, guided by the daring hunter who for years past had journeyed alone through the trackless wilds of the Southern Mashonaland bush, is in itself an epic. That no harm befell the column during its 400-mile adventurous march from Tuli to Fort Salisbury was in itself a remarkable proof of leadership and of diplomacy. In those great days of adventure, courage, and endurance the name of Selous ranked second to none in a company where all were brave and many remarkable.

In the stormy years that followed Selous maintained his high record of personal endeavour; to him no other course was possible. He took part in the overthrow of Lobengula in 1893; and again in 1896 when the Matabele rose against their conquerors he did yeoman's service, taking part in many dangerous relief patrols and in the larger operations which finally resulted in the suppression of the rebellion. It was a time of heroic endeavour and of the exhibition of that moral and physical courage for which Selous was distinguished. The writer well remembers his familiar figure, when the Salisbury Relief Column, with Cecil Rhodes at its head, met the Bulawayo Column under Colonel Napier, with whom was Selous, on the Shangani. The sight of him riding out with the scouts down the beautiful Insiza Valley was in itself inspiring; and at his side was frequently to be seen that most chivalrous and intrepid of leaders, Captain George Grey, now alas! no more. There too were Jack Spreckley, Bob Coryndon, Arthur Eyre, and many others: all forceful and notable personalities, worthy to ride with him whom we now mourn.

In later years Captain Selous' interest in Rhodesia had not waned. The writer has been privileged to meet him and discuss old times on many occasions at London Wall, and well remembers the pride with which early in the war he brought there his son who was about to receive a commission in the King's forces. Another recent memory is an address given recently by Selous at a dinner of the United Empire Club in Piccadilly. On that occasion he held a great company spell-bound while he told a tale of thrilling adventure in Northern Rhodesia in the simple and direct language which was typical of the man. But the art of it was astounding. It showed us in action the forceful personality, the keenness of observation, the readiness of resource, and the calm courage without which death would have been certain; it revealed to us those qualities of character which were always at his country's service, and which at his death remain with us as an enduring example.

H. WILSON FOX.

Captain Selous' fame as a big-game hunter and pioneer explorer has perhaps tended to overshadow his other great qualities and attainments, but it is safe to assert that had his brilliant achievements with the gun been less—considerably less—than they were, he would still have left an honoured name in the very front rank of field naturalists of his time. He

was a born naturalist; and though circumstances and inclination had their influence in leading him to adopt the adventurous life of a hunter, his inborn instincts were those of a naturalist pure and simple. Many are the incidents related by his contemporaries at Rugby indicating his keen and enthusiastic devotion to the pursuit of the bird's nester or butterfly collector. His splendid museum at Worplesdon contains many specimens of butterflies, moths, and birds' eggs collected by him when a boy, and it gave him as much pleasure to show these to his friends as to point out in his modest way some of his finest big-game trophies. His collection of birds' eggs is remarkable for the accuracy and care with which every clutch, all taken by his own hand, is labelled with date and locality. His early love for butterflies remained constant to the end, for in one of his last letters written from a locality in East Africa only a week or two before he was killed, he says:—

"This is the very worst place I have yet struck out here for butterflies, and I have not been able to find anything but a few species which are very common elsewhere." He pathetically adds: "Perhaps I may get into a better place and have a little time for collecting later on."

His connection with the Natural History Museum at South Kensington began in 1881, when he sent home for that institution a collection of about 150 mammals from Rhodesia. Since that year he maintained a regular intercourse with the authorities, and abundant evidence of the manner in which he enriched the national collections is to be seen in the magnificent series of mounted animals from South and East Africa, Alaska, and Newfoundland, which are among the most prominent and notable features of the Mammal Gallery. These groups indeed form an enduring national memorial of Selous' skill and prowess as a big-game sportsman, a memorial of which our country may well be proud.

Selous never made any claim to being a systematist or scientific worker in Zoology, but he was always ready to discuss points connected with the making and description of new species with experts, and he defended his opinions with a tenacity and with a knowledge derived from close and accurate observation that would often help to elucidate some doubtful conclusion.

One subject which Selous was fond of discussing with his friends and on which his views had a special interest was the theory of the protective coloration of animals. While he was a believer in the theory, and ready to furnish evidence of it in regard to many insects, he was never convinced as to its soundness in the case of the large mammals. He agreed with his friend Colonel T. Roosevelt in the opinion that the tawny hide of the lion and the stripes of the zebra and the tiger had nothing to do with concealing coloration. He would point out that the large Carnivores hunt by scent and not by sight.

Universal tribute to the fine and generous nature of the man has been paid. I need only say here that Selous was a most lovable man. He has

left an imperishable name in Africa and a memory ineffaceable in the hearts of his friends.

C. E. FAGAN.

THE KINEMATOGRAPH ON THE IGUAZÚ AND THE AMAZON

AT a Special Meeting of the Society held at the Theatre, Burlington Gardens, on Wednesday, January 3, Mr. F. H. Chevallier Boutell described a recent visit to the Falls of the Iguazú, and exhibited a fine series of kinematograph pictures of the falls. In the course of his introduction Mr. Boutell described the river Paraná, and showed many interesting pictures of the river traffic by orange steamer from Corrientes. One of the few industries on the river is the cutting of the hard wood quebracho, whose timber is sought for many purposes, as it is almost imperishable and has the virtue of not rotting between wind and water, while an extract very valuable for tanning is made from its bark. At Posadas, the capital of the Misiones territory, is an inclined plane by which the trains of the Argentine North-Eastern Railway are let down for conveyance to the Paraguayan side. Further up the river the port of Paranayi is noted for its large handling of yerba, which is loaded to the steamers by a shoot.

A few hours above Paranayi is the port of Krieger at the mouth of the river Nacundayi, on the Paraguayan side. About half a mile up the river is the beautiful fall illustrated in the plate and characteristic of this region of waterfalls.

Until recent years the approach to the falls from the mouth of the Iguazú was through terribly thorny and almost impenetrable jungle; to-day a road has been completed by the munificence of a wealthy Argentine lady, Miss Aguirre; a small port at the river mouth bears her name in memory of her generosity. It is comparatively easy to drive as far as the "hotel," a rough building where shelter is to be obtained. From the hotel paths have been cut through the forest to different points of the falls.

It is usual to visit the falls in winter when the volume of water is considerably less than in summer, especially in the falls on the Argentine side. In summer the insects and reptiles are more troublesome.

The falls of the Iguazú have little history. The territory of Misiones was the seat of that wonderful Jesuit organization that extended over the north-east corner of what is now Argentina, as well as over the greater part of Paraguay; but prior to this development the Spanish Adelantado Alvar Nunez, nicknamed Cabeza de Vaca, started from the Atlantic coast near to the Brazilian island of Santa Catalina, with the intention of cutting his way for several hundred miles through the almost impenetrable forests covering this unknown territory. He had with him a large body

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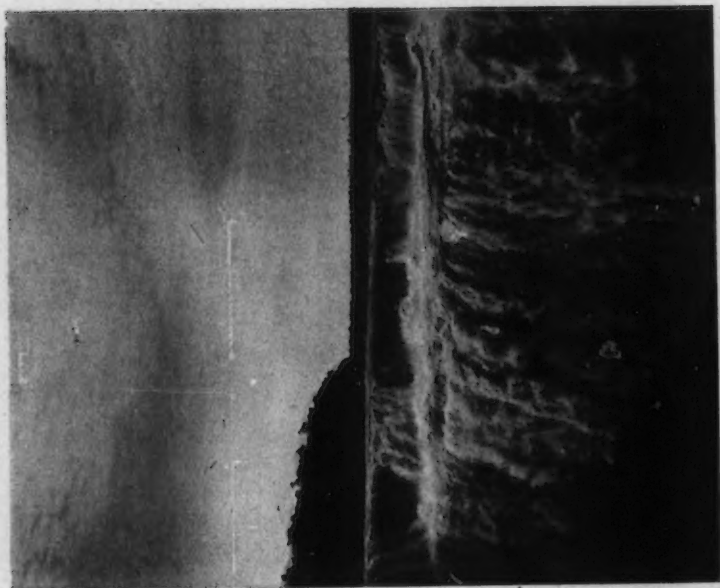




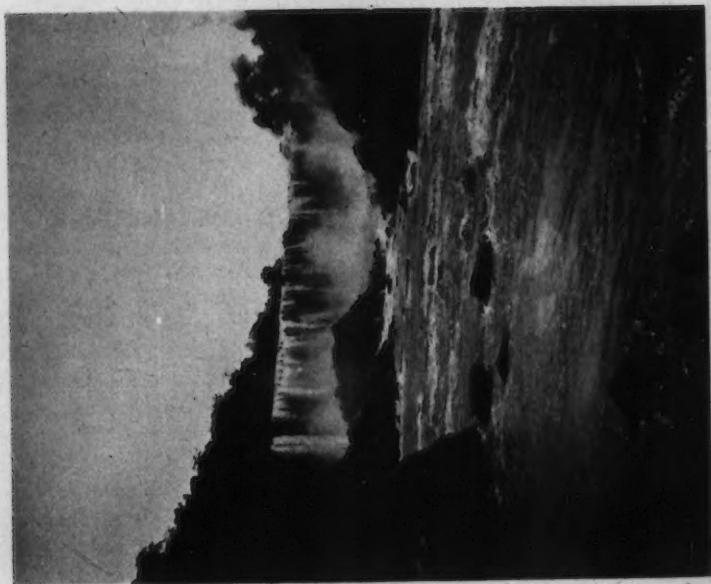
THE ARGENTINE HORSESHOE, IGUAZÚ FALLS, AT LOW WATER IN WINTER



THE ALTO PARANÁ



THE ARGENTINE HORSESHOE FROM ABOVE, IGUAZÚ FALLS



FALL OF THE MACUNDAYI, PARAGUAY

THE ARGENTINE HORSESHOE FROM ABOVE, IGUAZU FALLS

FALL OF THE NACUNDAVI, PARAGUAY



of hardy and tried warriors, and thirty-four days after his start he struck the upper Iguazú. After months of incredible sufferings the falls were reached. From this point he conveyed his soldiers by canoes to the mouth of the river and thence across the Alto Paraná to the Paraguayan side, the journey onwards through the Paraguayan Montes being a comparatively easy task. A long account of this interesting overland journey has been left; it is the first and only authentic account of such an expedition. Azara, in his excellent work on the "Missions," written in 1781, mentions the existence of the falls and gives a description of them, but it is so erroneous that it must have been the result of hearsay; enough, however, was known to satisfactorily establish their existence.

The first account of the falls in the publications of the Society is contained in the paper by Mr. W. S. Barclay, *Geographical Journal*, January 1909, in which there is a good description of the structure of these falls, and of the even more inaccessible falls of the Guayra—the latter based on photographs and descriptions of two Austrian travellers. A complete set of the pictures of the Iguazú Falls, taken by an official photographer both from the Argentine and Brazilian sides, is given in Mr. Barclay's guide 'To the Falls of Iguazú,' published in Buenos Aires in 1903.

The kinematograph pictures of the falls, taken from many points of view, gave a striking representation of the beauty of the moving water, and were received with loud applause by a large meeting.

In moving a vote of thanks to the lecturer the PRESIDENT said: "I could not help feeling a wish, while we were watching the beautiful pictures Mr. Chevallier Boutell has shown us, that a late headmaster, a friend of many of us, whose misfortune it is to occasionally say the wrong thing at an unfortunate moment, could have been here instead of at the Educational Congress. We find in our newspaper this morning Dr. Lyttelton denouncing the kinematograph as 'the greatest possible influence in the wrong direction at the present time.' Apparently he classes the invention among what a writer in the *Times Literary Supplement* on Thursday last characterizes as the 'new and worthless presents which science was always giving us.' 'We,' he complains, 'refused nothing, but clutched like greedy children at all the rubbish which science like a foolish parent lavished upon us.' The phraseology seems to me curious enough both in itself and the frame of mind it reveals to be worth preserving! For my part, I look forward to the more extended use of the lantern and kinematograph in schools and lecture rooms, as a valuable help in education. It has proved so in the United States.

"We must all have been struck by the width, the infinite variety, the elegance of the Iguazú Falls, and the wealth of the sub-tropical vegetation that surrounds them; and we are naturally drawn to compare them with the Victoria Falls and Niagara. They have much more in common with the former, which also, thanks to the genius of Mr. Rhodes, are happily still surrounded by an unspoilt wilderness. The Victoria Falls

are far higher, but less in width. It must be left for those who have seen both to award the palm between them. Mr. Chevallier Boutell has done the Society a service we fully appreciate in bringing here and showing us a series of pictures of unique interest, which it must have needed much energy, patience, and artistic skill to obtain in so remote and difficult a locality. We hope we may welcome him again on a future occasion when he may tell us more of his travels."

At a second special meeting held at Burlington Gardens on Thursday, January 11, Mr. J. Campbell Besley showed a magnificent series of pictures illustrating his recent journey from the Peruvian coast over the Cordillera of the Andes and down into the Amazon forests. At the request of President Billingham Mr. Besley in 1914 organized an expedition whose objects included an examination of the upper waters of the Apurimac, and an inquiry as to the fate of two missing parties of American explorers. In a continuous series of pictures lasting two hours Mr. Besley showed the incidents of the voyage, the journey from Mollendo to Cuzco and Lake Titicaca, the principal Inca buildings, the descent of the eastern face of the Cordillera to the headwaters of the Apurimac, and thence into the Amazonian forests, concluding with some especially fine pictures of the animal and reptile life. It is impracticable to describe in a brief space the incidents of the journey, which included many breathless descents of rapids on frail rafts. The procession of forest scenery as seen from the raft was of extraordinary beauty and interest. It is much to be hoped that those who had not the good fortune to be present at the meeting will have a further chance of seeing these pictures, many of which are of great geographical interest and educational value.

In thanking Mr. Besley at the close of the meeting the PRESIDENT said: "The lecturer has left me too little time to do anything more than thank him for the beautiful pictures which he has shown us. We are here today to see rather than to hear, and we have seen much. The Amazon is very familiar to those of our Fellows who remember our late Secretary's predecessor, Mr. Bates, whose book, 'A Naturalist on the Amazons,' is a classic and has been recently issued. I could not help wishing tonight that the spirit of Mr. Bates could return to see these pictures of what he has described so well. I do not know whether many of us can hope to view these scenes with our own eyes; but it is by no means impossible to see something of the beauties of the Upper Amazon on the least difficult transcontinental route—not, as you will have seen, that followed by Mr. Besley—which is not impracticable even for a lady. We shall keep in our minds Mr. Besley's pictures of these wonderful wildernesses and tremendous rapids, and we congratulate him on the good health with which he has come through so many hardships."

GERMAN PEACE MAPS

WE have received from a correspondent a map which has been put on sale in Berne, where at the time he wrote the people thought that they had "a sure thing for the Peace Congress." It is therefore of some interest to examine the contents of the "Politisch-geographische Grundlagen Europas für Friedensbetrachtungen," being No. 1 of 'Flemmings Friedenskarten, Herausgegeben von Prof. Dr. J. J. Kettler' (Flemming: Berlin und Glogau, 1916). The sheet contains three maps, covering identical portions of Europe. The first is from the point of view of the war positions, and shows in high colours the territories occupied by enemy forces on either side; there is in this nothing to note except that Luxemburg is left as neutral white as Switzerland and Holland, which scarcely represents the truth of its present condition.

The second map is coloured from the historical point of view, and one can obtain both instruction and amusement in examining the aspects of European history which the author considers of importance in the ultimate settlement of the present complications. The startling appearance of France comes from a brilliant band of colour which marks the extent of the "English conquests (Eroberungen) in France in the 12th to 15th centuries." We are duly grateful for the hint that this is how the enemy would wish to interpret for the discomfort of our Allies the history of the French territories of our Angevin kings. Passing eastward we find large portions of central Europe, approximately of the extent of the Holy Roman Empire at its greatest, coloured a brilliant yellow and labelled "Deutsches Reich nach dem Westfälischen Frieden i. J. 1648." The merits of this label for the Empire concern Austria more than ourselves, and we may leave it to their candid appreciation. The domains of the Teutonic Knights are coloured a beautiful pink with the label "Gebiete des Deutschen Ordens," but by some lapse of memory the editor has forgotten to add to the label a date, showing that the greater part of these territories were lost in the sixteenth century, and the fact that the remaining possessions of the Order were held by them as a fief of Poland. The kingdom of Poland is shown in the sixteenth century before its union with Lithuania; and Lithuania of the same date before its union with Poland. But there is no boundary of Poland before its first partition; and Napoleon's Grand Duchy of Warsaw figures only as an appanage of France. Austrian Silesia is, of course, contained in the old Polish boundary, but by another oversight the editor has failed to show that Prussian Silesia also once belonged to the same kingdom. The French province of Illyria in Napoleonic times makes a striking appearance along the Dalmatian coast, but whether its representation is intended to discourage the Italians or the Yugo-Slavs is difficult to say; nor can one conjecture the interest of showing the boundaries of the Ukraine in the thirteenth century. The editor's history stops short at the approach to the Balkans, and his map throws no light upon what may be the German point of view of historical boundaries in this important part of the world. Is it to be supposed that historical facts are here not worthy of consideration?

The third map shows Europe from the ethnographical point of view. It follows in the main the representations familiar in German atlases. By the use of a brilliant red for Germans the scattered German settlements in southern Russia and on the Volga are given an importance which is certainly excessive, since the German population in these districts does not anywhere much exceed ten per cent. of the whole (see "Die Deutschen in Russland," Ernst Hasse, *Die*

Deutsche Erde, 1905, p. 205). We note an uncandid dealing with the Slavs, whereby the Čechs, Slovaks, and Slovenes are left white with the Magyars as "other races" (sonstige Völker), and their relation with other Slavonic peoples south and east is unrepresented. The line of division between the Bulgars and the Serbo-Croats is not in accordance with the political spheres of Bulgaria and Serbia as defined by the secret treaty of 1912.

We are greatly indebted to our correspondent in Berne, and hope to receive the succeeding numbers of this instructive series of "peace maps."

REVIEWS

ASIA

A Historical Geography of the British Dependencies.— Vol. 7, India. Part I. (History). P. E. Roberts. Oxford: Clarendon Press. 1916. *Sketch-maps*. 6s. 6d.

THE geography of India is not combined in this work with the history, but is to be dealt with in a separate volume. Only a brief summary of the leading surface features of the country is here prefixed, without which the history would be difficult to appreciate. On broad lines it fulfils its purpose. It might have been pointed out, however, that the mountain barrier could be, and probably was, turned from the west, before the comparatively modern desiccation of Mekran and Seistan took place. Then again it cannot be said that until modern times the Ganges delta was the gate of India from the sea, unless the period before the Portuguese settlements be ignored. The history is that of India as a British Dependency, so previous events are treated cursorily. In the account of the earlier transactions of the various trading companies which settled along the coasts a commendably full use is made of the records of the British East India Company, now available, thanks to the indefatigable researches of Mr. W. Foster. The next section of the volume is occupied with a fairly comprehensive account of the Anglo-French struggles for supremacy in Southern India, and the rest is concerned with what happened after the course of events had assumed a more definitely political character. Before this, the history being that of a number of separate and isolated settlements, the narrative has to sway from one side of India to the other, but from the time of Clive the sequence is, as usual, that of the term of office of the successive heads of British Indian administration. A considerable portion of this section is devoted to the "purple patches" of controversy which arose in the latter half of the eighteenth century, upon which much fresh light has been thrown within the last twenty-five years or so. The case on both sides is fairly set forth, and the judgment of the author is, on the whole, impartial. The more accurate results of modern investigation, however, have against them the literary brilliance of Burke and Macaulay, whose damnatory verdicts will long continue to warp the judgment of the more youthful students of the rise of British rule in India. The later narrative follows the usual lines, with the incorporation of some useful information upon special points culled from recent biography. There is a good index.

J. A. B.

Provincial Geographies of India—The Panjab, North-West Frontier Province and Kashmir.— Sir James Douie, M.A., K.C.S.I. Cambridge University Press. 1916. *Maps and Illustrations*. 6s. net.

Every part of India has its special interest, and none more markedly than the region described in this volume. The height and breadth of the mountain

rampart on the north, the depth and volume of "Abu Sindh," or Father Indus, on the west, and the desert on the south, leave only the upper Jamna basin open for free intercourse, with its neighbours, and it is here that the Panjab merges almost imperceptibly into a more typical India. From the opposite direction wave after wave of foreign irruption across the Lower Indus or by the Kabul Passes have left their traces upon the character and religion, and also to a certain extent upon the blood of the population. Here, accordingly, problems have to be solved which do not arise in other Indian provinces. Border tribes have had to be controlled; a martial people, in arms against the British less than seventy years ago, have had to be conciliated, and mighty rivers harnessed for the fertilization of vast tracts of land otherwise unproductive. It is fitting, therefore, to place the description of the Province and its surrounding States in the hands of one who has been associated with the administration, from the charge of a district to that of the Province, for thirty-five years, and is consequently intimate alike with the highways and byways of the whole country and with the life of its inhabitants. This familiarity and the sympathy bred of it is apparent throughout the work, and where the subject is highly technical, as in the case of geology and numismatics—the latter being of unusual importance in the Panjab—the author has enlisted the help of well-known experts. The result is a mine of trustworthy information, especially to those who refer to it upon some definite point. On the other hand, a thorough knowledge of the subject in all its details and difficulties tends occasionally towards an elaboration of its subdivisions somewhat confusing to one whose object is to obtain a general view of the conditions as a whole. The form, in fact, is more that of a Gazetteer than a geographical study, and the work would be improved by a closer co-ordination of the physical features with the history and life of the people upon whom they react, and by whom they have been adapted to current needs. It may be suggested, too, as tending in the same direction, that the geographical unity of the three tracts, to which, as well as to their political unity, attention is directed by the editor, would be best demonstrated by the inclusion of all three in a single map; or, at least, that in the otherwise adequate maps of each division appended to the volume the adjacent territories should be indicated. It may be noted in passing that in more than one place in the text there is a transposition, probably typographical, of east and west: also, in treating of rivers as tortuous as some of those described, it is safer to locate places or natural features in reference to them by the bank, rather than by the point of the compass. The work is copiously provided with illustrations which have the signal merit of being really illustrative.

J. A. B.

AMERICA

The Conquest of Virginia. The Forest Primeval. An Account, based on original documents, of the Indians in that portion of the continent in which was established the first English colony in America.— By **Conway Whittle Sams, B.L.** New York: G. P. Putnam's Sons. 1916. *Maps and Illustrations.* 18s. net.

In calling his book 'The Conquest of Virginia' Mr. Sams wishes to emphasize the fact that Virginia was not colonized by Englishmen without a struggle with the original possessors of the land. But the title is misleading, not only because he gives no account of the conquest, but also because in a military sense the word "conquest" does not convey a correct idea of the course and outcome of Indian warfare in Virginia. Captain John Smith did in fact propose to the Virginia Company a regular campaign against the Indians

as the best method of procedure, but his suggestion was not followed. Desultory fighting and raiding, bargaining and persuasion, and the retreat of the Indians before the advancing settlers continued. The substance of Mr. Sams' book is a description of the manners, customs, and institutions of the Indian tribes in Virginia, made up of extracts from early writers, such as Hariot, Spelman, Smith, and Strachey. He arranges all this matter well, with many interesting illustrations, and it is good to have the available information about the Indian peoples brought together in this way. In his last chapter he gives a useful classification and separate account of the various tribes and nations. But the material wanted more digestion to become history.

E. A. B.

GENERAL

Intercourse between India and the Western World from the Earliest Times to the Fall of Rome.— H. G. Rawlinson, M.A., I.E.S. Cambridge: University Press. 1916. 7s. 6d. net.

Prof. Rawlinson has examined a large and important question of general history—the early relations between India and the Western World. The materials available for such a study, so far as the classical literatures are concerned, are not very extensive and do not point to any close connection between East and West in ancient times. Neither Greek nor Roman influence seems to have gone very far in Asia, nor conversely did Indian and other Eastern civilizations contribute much to the formation of European life. East and West lived their separate lives. Though Indian soldiers accompanied Xerxes' army and passed through Thermopylæ (and thus fought in Europe more than two thousand years ago), Greece and India seem to have been almost entirely ignorant of each other. There was trade, of course, but over such long routes it carried little mutual influence. Herodotus, in fact, seems to supply the first description of India by a Western writer. There was a "close and friendly intercourse" between the Maurya dynasty and the Syrian kings, and to that we owe Megasthenes' account of the Maurya empire, without which we should know little of India at that time. "When the Roman Empire was extended eastwards the trade in luxurious products seems to have been very considerable. Yet it is astonishing that Strabo, who had travelled in Armenia and up the Nile, seems to have been able to get little first-hand information about India. In the middle of the first century A.D. there were improvements in navigation which brought India within two months' journey of Alexandria, and Pliny the Elder was able to write a fuller story. Yet what stands out from this study of a thousand years of history is how little India and the West had to do with one another. Prof. Rawlinson tells us that India learnt of Greece in the art of coinage and the science of astronomy and in little else, while "of the great civilization of ancient India, its philosophy and religion, Greece knew—and cared—nothing." Further research may work out more fully the details of the relations between India and the ancient world; but Prof. Rawlinson's valuable and original work seems to establish the main fact of their almost completely separate development. So much does the exchange of ideas depend on economic progress.

E. A. B.

Naval and Military Geography of the British Empire.— Vaughan Cornish. London: H. Rees. 1916. *Maps.* 3s. 6d. net.

It is not often that one meets with so much useful information of a theoretical rather than statistical character packed within so small a space as

is compressed into Mr. Vaughan Cornish's modest volume. The booklet includes a series of short lectures given during the war period to officers of the navy and army, well illustrated by maps, and intended, presumably, to be in extension of the usual technical instruction which all naval and military officers are supposed to receive before they become active members of the services. It is, as its title implies, strictly Imperial in the scope of its teaching, and strictly related to the conditions of a war with Germany. Consequently there is little in it which bears on the influence of regional geography in naval or military manœuvres; nothing, for instance, to explain the effect of sea-bottom conformation on the use of submarines, or the important military aspects of mountains, rivers, deserts, etc., on the conduct of a campaign. Nor can it be admitted that the deductions which are drawn from a consideration of the distribution of naval centres with respect to their technical bases of supply would be justified in case of a war with any other country than Germany or France. But the examination of the geographical conditions which affect the interdependency of Great Britain and her overseas dominions, with due insistence on the centrality, or (to take the latest expression) nodality of certain points, such as the Suez Canal or Cape Town, is both instructive and suggestive. Possibly too much is made of the factor of distance, because distance and rate of transport is largely governed by a factor which is apt to be variable, *i.e.* that of speed; and whilst the centrality and extraordinary strength of Germany's base of supply is rightly emphasized there is hardly sufficient comparison drawn between her power of reaching important points in the many war areas (expressed in terms of time) and that of the allies acting on outer lines. The geographical conditions governing the distribution of Imperial forces—Canadian, Australian, Indian, and West Indian—which were, under sudden pressure at the commencement of the war, disregarded, and the necessary arrangement resulting therefrom, might perhaps be considered as beyond the scope of the work; at any rate nothing is said about them. It is however a very important aspect of the geographical position. Very rightly is the importance of the allied occupation of Salonika insisted on. Any one who is unconvinced of the value of this position should read chapter vii. of the second part of the book. The lectures on India and Mesopotamia are not quite so convincing, although the author does good service in pointing out that the right of way from Berlin to the port of Germany's desire in the Persian Gulf is practically in her hands already. Whether she can ever make use of it is another matter. The book is so handy and so full of important suggestion that it should be studied by every one who takes an interest in the greatest war of history.

T. H. H.

THE MONTHLY RECORD

EUROPE

Fast Racial Movements in Europe.

Mr. Madison Grant has essayed a somewhat difficult task in attempting to represent graphically by colour-maps "the original distribution and the subsequent expansion and migration of the three main European races, known as the Mediterranean, the Alpine, and the Nordic." The four maps in question were prepared to accompany the author's book 'The Passing of the Great Race,' published last year by Charles Scribner's Sons of New York, with whose consent they have been reproduced in the *Geographical Review* for November 1916, with explanatory letterpress. Complete success in such an attempt is perhaps not to

be expected, for each of the maps deals with an extended period, the general tendency towards movement within which has to be portrayed, and not the facts of distribution at any one moment. The difficulty is partially got over by the use of arrows indicating the lines of migration and by breaking up the main colour-masses near their margins to represent the gradual encroachment of one or other of the types on the domain of its neighbours. The first map shows in a generalized way the distribution of races at the time of the great invasions of the Alpines with Bronze culture, put down as between 3000 and 1800 B.C., with a maximum towards the end of the period, when the Neolithic had given place to the Bronze age. The green which represents the Alpine type here occupies a broad belt between the Mediterranean and Nordic (or Boreal) races, the great lines of invasion from the region of the Armenian highlands being shown by black arrows emanating from a central trunk route. Besides the southern peninsulas the Mediterraneans had extended themselves over North-West France and the British Isles, while the Nordics had spread from Russia into Scandinavia, where they specialized into the race now known as Scandinavian or Teutonic. The second map shows the shattering and submergence of the Alpine area by the expansion of the Nordics, whose encroachments in Central and Western Europe left the Alpines only as a substratum except in mountainous and infertile districts. The Scandinavian branch equally pushed its onward way to the south of the Baltic and North Sea, while movements to the south and south-east extended the Nordic influence to Greece, the Caucasus and Persia, and even to India. The period represented by this map closes at 100 B.C. The third map, representing the period 100 B.C.—1100 A.D., shows the continued great expansion of the Teutonic, coupled with a marked expansion of a branch of the Alpines—the Wends and Sarmatians—ancestors of those Alpines who are to-day Slavic-speaking. This expansion, from which in time came the bulk of the Russians and Southern Slavs, is one of the most significant features of the Dark Ages. The last map represents the distribution at the present day and brings out the racial conflict along the whole zone of contact between the Nordics and Alpines, from Northern France to Finland, the continued expansion of the Alpines being no doubt one of the ultimate causes of the present war.

Marseilles and its Communications with the Interior of France.

A good deal of interest has been aroused in the progress realized last year in the improvement of means of communication between Marseilles and the country behind it, from which it has been in the past singularly isolated by the physical nature of this part of Southern France. Unlike other great ports, which owe their importance to a position on navigable rivers or on the borders of plains easily traversable by canals and railways, Marseilles is cut off from the interior by a belt of broken country (the "Chaîne de la Nerthe") offering an obstacle to transport quite out of proportion to its absolute altitude. The Marseilles-Paris railway crosses this by a tunnel nearly 3 miles long, and the only other line to the north has been the single track running with steep gradients by Gardanne to Aix. Last year saw the completion of a difficult undertaking by which an alternative express route, avoiding the use of the Nerthe tunnel, has at last been supplied. The new line, constructed by the Paris-Lyon-Mediterranean Company, involved engineering feats of considerable magnitude. It first hugs the coast for some miles to the west of Marseilles, then turns north towards the outlet of the Etang de Berre, which it crosses, then making use of the previously existing branch line connecting Port-de-Bouc

with the old main line at Miramas. In its coast section it passes through no fewer than twenty-two short tunnels, with many bridges and viaducts. The crossing of the outlet of the Etang de Berre necessitates a viaduct over half a mile long, with a turning bridge having a span of over 100 yards. These details are taken from a note on the subject by M. Rabot in *La Géographie* (October 1916), which also refers briefly to a second undertaking for giving Marseilles improved access to the interior—that of the construction of a canal linking the port with the Rhone at Arles (see also article by P. Gribaudi in the *Bollettino* of the Italian Geographical Society, 1916, pp. 547-574). This canal crosses the Chaîne de la Nerthe by a tunnel 4½ miles long, known as the Tunnel du Rove, the piercing of which was successfully completed in May last, though it will be two or three years before the canal can be opened for through traffic. Even when the Rhone is reached the navigation of this rapid river is of course not without its difficulties, but the improvements of the past thirty years have vastly increased the volume of traffic, and when the new project is completed a further great development is expected.

AFRICA

Livingstone Relics at Koloben, Bechuanaland.

By the courtesy of the Colonial Secretary we have been favoured with a copy of correspondence which has passed between the Resident Commissioner of the Bechuanaland Protectorate and the High Commissioner at Cape Town respecting the preservation of the remains of Dr. Livingstone's house at Koloben, and of the graves in its vicinity. It appears that action in this direction was the outcome of an appeal by Sir Meiring Beck that steps should be taken to preserve these mementoes of Livingstone's early missionary labours, dating from his residence among the Bechuanas before starting on his great exploring journeys to the north. Through the co-operation of the chief Sechele the ruins have now been fenced in and a shed has been erected over the remains of the walls of the house. The ground will in future be regarded as under Government protection, and Sechele has been impressed with the necessity of keeping the site clear of jungle and guarding against injury by veldt fires or cattle. The headman of a neighbouring village has been placed in charge, and an inspection of the site will be made from time to time.

Egyptian Locust Invasion of 1915.

A report issued last year by the Ministry of Agriculture, Egypt, gives an interesting account of the great invasion of locusts in 1915, one of the most formidable of recent times, but also one of the most successfully combated, thanks to the prompt and systematic measures adopted. The report brings out clearly the facts regarding the course of the invasion, the influence of weather on the migrations into the Nile valley, and the special conditions bearing on the methods of destruction suitable to the country; it is of special interest from the fact that the invasion of 1915 was the first of any magnitude since the institution of a Government Agricultural Service in Egypt. It appears that within recent times intervals of about a decade have elapsed between the successive visitations, the last serious one having occurred in 1904. In 1915 the first intimation of the arrival of locusts in the Nile valley were by telegram from Fayum and Wasta on February 2, and steps were at once taken to ensure the proper reporting of the movements of the swarms and the adoption of means for their destruction. It was proved that the locusts came both from the west and from the east, as they had done during a minor visitation in 1914. Comparison of dates showed that a barometric depression crossed the Nile valley

or affected it almost every time a fresh wave of the invaders came, and the connection is only natural seeing that the direction of flight is to a great extent governed by the direction and velocity of the wind. To bring an invasion the depression must however pass close enough to make its influence felt, at a place where locusts have bred and are in exactly the right stage to migrate, or where migrating locusts are resting. The fact that Egypt has practically no vegetation apart from the cultivated crops renders methods of destruction unsuitable which are correct ones for pastoral countries like South Africa and the Argentine, and makes it imperative to kill the locusts before they begin to feed. For Egyptian conditions the best method is to drive the "hoppers" into small trenches and bury them. This proved very successful, though means were also found to kill both adults and eggs. Contact insecticides were found useful to some extent, but the use of internal poisons is not suited to Egypt. Thanks to the measures taken no locust swarms arrived at maturity, and the damage done was very small. Although the docility of the Fellahin lightens the task in Egypt, Government superintendence of the operations is absolutely necessary.

AMERICA

Recent Retreat of an Alaskan Glacier.

The great Alaskan glaciers offer a field for study second to none in the world, and of this due advantage has been taken of late by American investigators. Various glaciers have been visited at fairly frequent intervals, and the observations made and photographs taken permit the recent variations of the glaciers to be followed with some minuteness. One such is the Barry Glacier, which enters the arm of Prince William Sound known as Port Wells. The latest visitor to this, Mr. B. L. Johnson, describes the evidence for the recent retreat of the glacier in *Professional Paper* 98-C of the United States Geological Survey. The last previous visitor, Prof. Lawrence Martin, had found in 1910 that the glacier-front had retreated from Doiran Strait (at the junction of Barry Arm with Harriman Fiord), which it almost closed when first described by Glenn and others in 1899, over 2 miles up Barry Arm to a point near the confluence of the two tributary glaciers, Coxe and Cascade. Mr. Johnson visited the locality in 1913, and again in 1914, finding that the retreat had been continued so as to entirely separate Coxe Glacier from Barry Glacier, and to leave only a slight connection between the latter and Cascade Glacier. The surface of the Barry Glacier was also considerably lower. The greatest retreat was on the eastern edge of the Barry Glacier, and amounted here to about 8200 feet between 1910 and 1914. Photographs of the several glaciers at these two dates accompany the paper.

Changes in the Kentucky Mountains.

The Kentucky mountaineers are often put forward as a striking example of a people whose seclusion from the outside world by geographical conditions has left them more or less untouched by the march of civilization, so that they still afford illustrations of the modes of life of two or three centuries ago. This aspect of Kentucky life was well described by Miss Semple in a paper printed in the *Journal* sixteen years ago (vol. 17, p. 588). It is a question of much interest how long the conditions described by her are likely to remain unchanged or have already shown signs of modification by new developments. This subject was dealt with by B. S. Shockel in the *Scientific Monthly* for August 1916. After briefly noting some of the causes of their past isolation, the writer remarks that "outside capital has begun to develop the coal and

timber resources of the region, a fact which is bringing about many changes in the mountain country, and that rapidly. As a result the inhabitants are facing the crisis brought about by the sudden mingling of a primitive people with the exploitative phase of modern civilization." Coal is undoubtedly the chief mineral resource of the region, seams occurring in every county, but reaching their climax in the Black Mountain region. Railways have lately been opened in this direction, and the development of sites near the mining centres, especially Jenkins and Hazard, has been spectacular. Although timber has been, and is, the chief source of wealth, its area has been much reduced and the end is in sight. Agriculture compares unfavourably with that of neighbouring regions, though the shale soil is fairly fertile and produces well on gentle slopes. The chief causes of the low productivity are steep slopes, poor cultivation, and lack of crop rotation. Manufactures have always been primitive and for local use, but a new development is arising round the new mining centres. Deficiency in means of transport is still the great drawback, and until it is remedied but little improvement on a large scale can be expected. In spite of unfavourable circumstances there continues to be a large increase in the mountain population—greater than that in the State as a whole, and emigration has been necessitated by the inadequate food-supply. The public health leaves a good deal to be desired, and education is in a backward state, though an earnest effort for its improvement is being put forth. The writer ends with some judicious remarks on the harm to be anticipated from the rapid exploitation of the region, leading to the destruction of its resources and natural beauty, and the passing away of the distinctive character and pleasing traits of the mountain folk.

The Economic Regions of the United States.

This is the title of a paper by Professor Dryer in the *Geographical Review* for October 1916. He points out that "in extent and complexity the United States is comparable with the whole of Europe. To deal with it from the standpoint of economic geography it is necessary to divide it into economic regions, based on differences of natural environment." The division therefore takes into account the physical conditions, though the lines of demarcation invariably follow state boundaries. In cases in which a state includes territory belonging to two different natural regions, it is treated as a whole and placed in that region in which its more important industrial and commercial activities occur. The main dividing line of the United States is considered to be that which separates the west from the east in the neighbourhood of the 100th meridian, almost coinciding with the 2000-foot contour line and the 20-inch isohyet, but a tier of States from North Dakota to Texas is almost bisected by this line and these states are included in the eastern section. The western section is sub-divided into the "Pacific States" of Washington, Idaho, and California, and the remaining ones, characterized by their aridity, are termed the "Interior States." The eastern section is sub-divided into three groups: (i) The "Southern States" extend across the continent eastwards from Texas to the Atlantic and include on the north Indian territory, Arkansas, Tennessee, and North Carolina; this region is therefore almost exactly limited by the parallel of 36 $^{\circ}$ N., and consequently its boundary as seen on the map strikes one as being very "artificial." (ii) The "Middle West" includes the greater part of the upper basin of the Mississippi, and the states which constitute its eastern portion are Ohio and Kentucky; the north-eastern trend of the winding border seems more "natural" as it suggests that the Appalachian highlands

form its frontier. (iii) The "Eastern States" from the Virginias to New England form the last and smallest region. The essential characteristics of each economic region are very concisely described, while its economic conditions are displayed in a long table of statistics which show its relation to the United States as a whole; thus the Eastern States region has 18 per cent. of the total land area with 33 per cent. of the population, it produces 51 per cent. of the manufactured commodities including 63 per cent. of the cotton goods, and obtains 60 per cent. of the coal but only 15 per cent. of the total farm products, while its total wealth is 35 per cent. of that of the whole of the United States. Assuming that the division should follow state boundaries and that only a small number of regions should be formed, this study is most useful; we do not see how the broad divisions could be improved, and the descriptions and statistics give the facts which are really important in relation to the regions. If the tables of statistics gave the absolute as well as the relative values, *e.g.* the actual population in millions of the Eastern States group, their usefulness would be distinctly increased. Attention should also be drawn to the ingenious (but scarcely fool-proof) diagrams in which the relations of one set of conditions to another, *e.g.* area to population, or agriculture to manufactures, are shown by the shape and length of sides (but not area) of a series of rectangles. It is doubtless right to initiate an economic division of the whole area by taking the states as units, for the statistics on which comparisons must be based may be fairly easily obtained, but it is to be hoped that Prof. Dryer may find it possible to continue the study by modifying the "artificial" boundaries so as to reflect more closely the actual conditions. This would involve much research into the physical and the economic conditions, and in all probability only rough estimates of the industrial and commercial activities could be made; the division would lose its simplicity and the statistics would possess less accuracy, but the actual conditions would be more clearly shown, and the general result might be a truer appreciation of the economic geography of the United States.

J. F. U.

Affiliation of American Mountaineering Clubs.

With a view to the more efficient prosecution of their common aims, the chief Mountaineering Clubs of the United States and other societies indirectly interested in mountaineering have joined in a central organization with headquarters in New York, to be known as the "Bureau of Associated Mountaineering Clubs of North America." The idea found a zealous champion in Mr. LeRoy Jeffers (a Fellow of this Society), who has become first Secretary of the New Bureau, and is also Librarian of the American Alpine Club and an official of the New York Public Library. We have received from Mr. Jeffers a copy of the first *Bulletin* issued, giving information as to the membership, officers, and activities of the principal clubs and societies represented, the list including (besides the American Alpine Club, the Appalachian Mountain Club and others) the American Geographical Society, and the Geographical Societies of Philadelphia and Chicago. In addition to the supply of information and the promotion of co-operation between the members of the several bodies—reaching in all a total of over ten thousand—importance will be attached to the formation of a central library of mountaineering literature, and a collection of photographs and views of mountain scenery. In this direction a good beginning has already been made at the New York Public Library, where the Library of the American Alpine Club has also been deposited. Mr. Jeffers has compiled a useful selected list of the mountaineering literature to be consulted at the New York Library.

OBITUARY

Professor H. Mohn.

PROF. Henryk Mohn, born in Bergen in 1835, early devoted himself to the study of magnetism and meteorology. On the foundation of the Norwegian Meteorological Institute at Christiania in 1866 he was appointed Director, and filled this responsible position for forty-eight years. He survived his retirement only three years, and died in Christiania in September last at the age of eighty-one. Prof. Mohn worked up his department to a state of high efficiency. He attacked the problems of sub-Arctic meteorology with a steady perseverance which brought Norway abreast of any country in the world in regard to its meteorological service. He co-operated with Prof. Hildebrandsson of Upsala in studying the storms of the Scandinavian peninsula; and on the International Meteorological Committee he was one of the strongest supporters of international co-operation in scientific work.

Prof. Mohn took part in organizing and working up the results of the observations made by the *Vöringen* on the Norwegian North Ocean expedition in 1876-78—the first of the successors of the great *Challenger* expedition. He made detailed studies of the meteorological data of Dr. Nansen's successive Arctic expeditions, and his memoir on the meteorology of the *Fram* expedition is a very notable contribution to our knowledge of the polar regions. Almost his last work was the discussion of Captain Amundsen's Antarctic observations.

Prof. Mohn did much valuable work in oceanography also, dealing with the temperature and currents of the North Atlantic. His interest in the polar regions extended to the geographical aspects, and he was the author of several papers on Spitsbergen. He travelled much in Europe, and was a regular attendant at the meetings of the International Geographical Congress. He was a Corresponding Member of the Royal Geographical Society.

H. R. M.

Captain A. L. A. Mackintosh.

Æneas Lionel Acton Mackintosh was born in India in 1881 and was educated in England at the Bedford Modern School. He entered the merchant service, and in 1899 obtained an appointment in the P. and O. Line. When Sir Ernest Shackleton was fitting out his Antarctic expedition in 1907 Mackintosh with leave from the Company joined the *Nimrod* as second officer, and in the next year received a commission in the Royal Naval Reserve. By an accident during the landing of stores at Cape Royds in January 1908 Mackintosh lost an eye, and to his bitter disappointment, for he had been selected for the land party, he was obliged to go back with the ship to New Zealand. He recovered in time to return with the *Nimrod*, and nearly lost his life in a plucky effort to sledge with the mail-bag over 25 miles of sea-ice. He had much experience of ice travelling on the Barrier before the return of the expedition.

When Sir Ernest Shackleton organized his expedition of 1914 he gave Mackintosh the command of the *Aurora* and of the Ross Sea party. On reaching Hut Point in 1915 Captain Mackintosh went south with the parties engaged in laying depôts on the Barrier for the relief of the Shackleton party, who were expected to cross the Weddell Sea. But when the *Aurora* was blown out to sea from Cape Evans in May 1915 no news of these parties had been received, and some anxiety for their safety was felt. It now appears that they reached Cape Evans soon after the ship was blown away, and in the following sledging season succeeded in establishing the depôt in 84° South, which was their main duty. Their severe difficulties on the return journey are told

elsewhere in this number. With great courage and determination they had been surmounted, when by misfortune, almost within sight of Cape Evans, Mackintosh and Hayward were lost by the breaking up of the sea-ice in a blizzard on 8 May 1916.

H. R. M.

CORRESPONDENCE

Kut-al-Amarah.

Simla, 27 December 1916.

IN your issue for August 1916 the origin, pronunciation, and meaning of the name Küt-al-Amārah were discussed at some length by one of your correspondents. When I visited this village in January 1914 I made the following note in my diary:—

“*Kut* means a permanent habitation, generally walled and defensible either on that account or because of its permanent buildings. The Amārah are the principal division of the Bani Rabi'ah tribe of this part of 'Iraq. The name Küt-al-Amārah is spelt thus كوت الأمارة. The name of the town of 'Amārah (lower down the Tigris) is spelt differently thus عمارة.”

The meaning of the word Küt has no connection whatever with *situation*. The term is often applied to a particular ward, or quarter, of an Arab town, such as Hofūf, for example, where of course there is no river. The names Amārah and Muhammarah have clearly no connection with one another.

C. C. R. MURPHY,
Lieut.-Colonel, General Staff.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1916-1917

Special Meeting, 3 January 1917, at 5.30 p.m.—The President in the Chair.

PAPER: The Great Falls of the Iguazú. F. H. Chevallier Boutell. Illustrated by Kinematograph Films.

Fifth Evening Meeting, 8 January 1917.—The President in the Chair.

ELECTIONS.—Margaret L. Bazley; Capt. J. E. B. Hotson; Lieut. Ernest Victor Hugo, R.N.V.R.; Sam Senior; John Edward Newman Sherwood; George Frederick Spaulding; Albert Sydney Watson.

PAPER: The Geography of South American Railways.

Special Meeting, 11 January 1917, at 5.30 p.m.—The President in the Chair.

PAPER: The Amazon River and Unexplored South America. F. Campbell Besley. Illustrated by Kinematograph Films.

Sixth Evening Meeting, 22 January 1917.—The President in the Chair.

ELECTIONS.—Florence Abraham; Lieut. Walter George Bowie; Rev. Arthur Grime; Frederic Dundas Harford; Robert Turnbull Lang, J.P.; Rev. George Cecil Niven; Capt. the Hon. William Ormsby-Gore; Walter Fitz-Roy Prins; T. R. St. Johnston; Wallace J. Young.

PAPER: Yunnan and the West River of China. E. C. Wilton.

Seventh Evening Meeting, 5 February 1917, at 5.30 p.m.—The President in the Chair.

ELECTIONS.—Alfred M. Collins; Howard Andrus Giddings; Lennox Bertram Lee; Lieut. Henry G. Park, R.N.R.; Annie S. Peck; H. de Vasconellos; Andrew Weir; William Weir.

PAPER: Thirty Years' Work of the Royal Geographical Society, Dr. J. Scott Keltie.



